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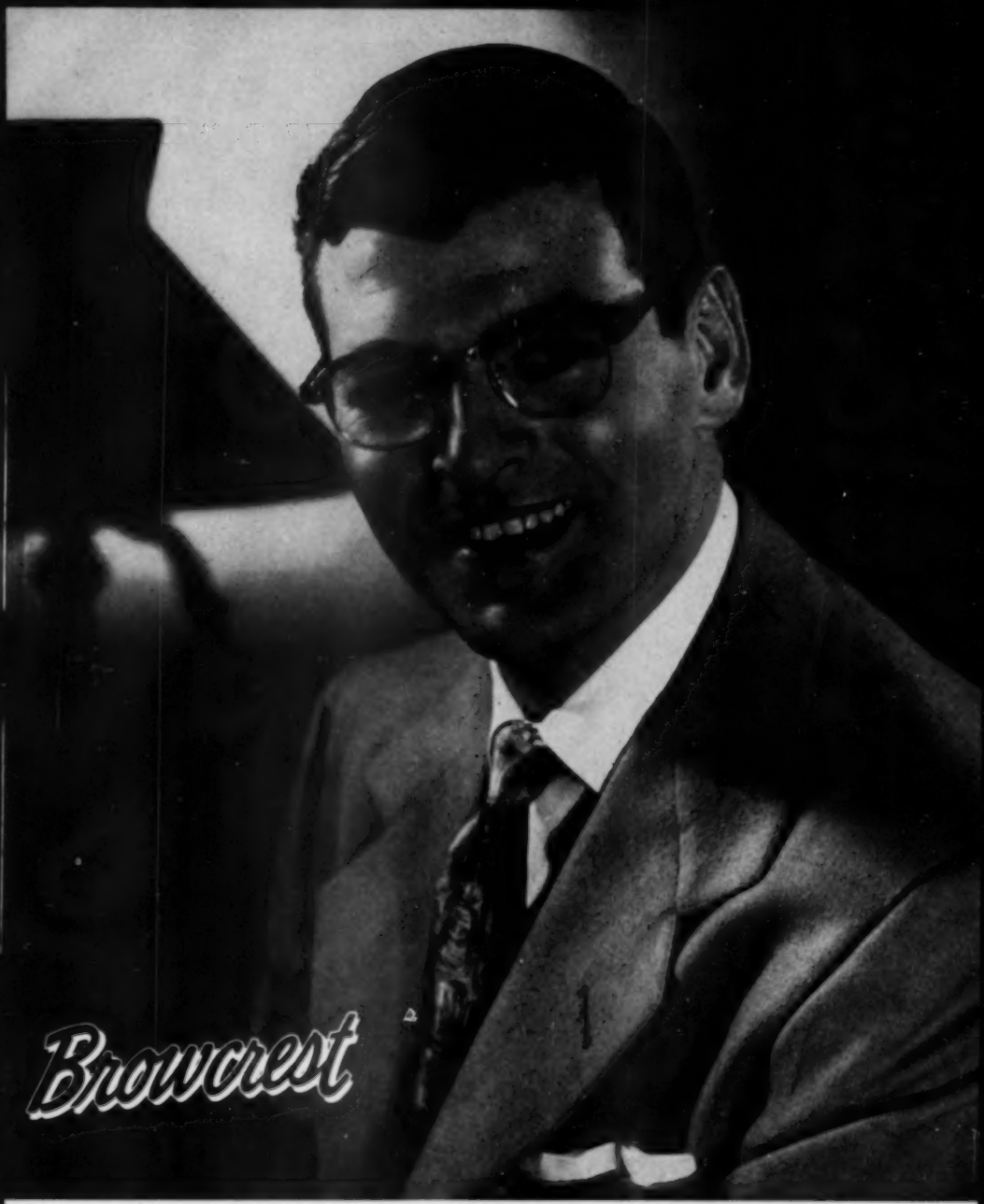

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Vol. 29 — No. 8

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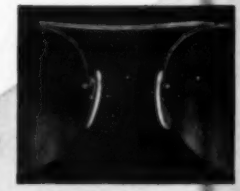

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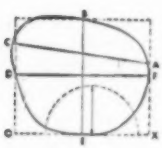

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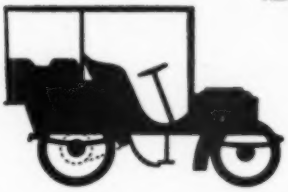

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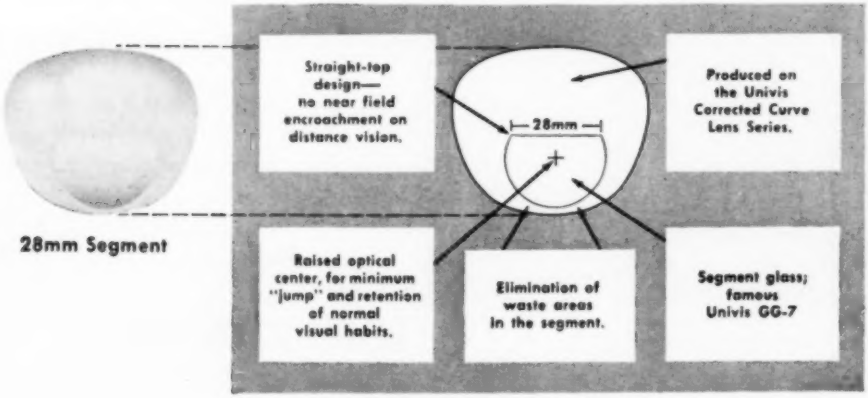
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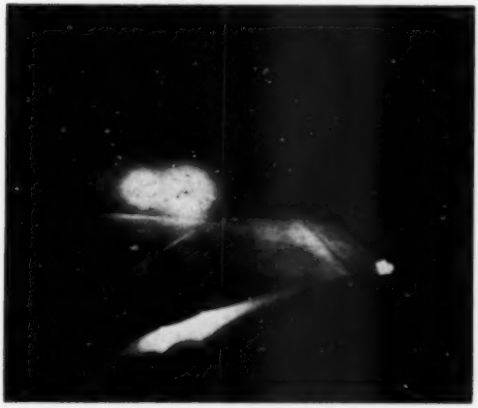

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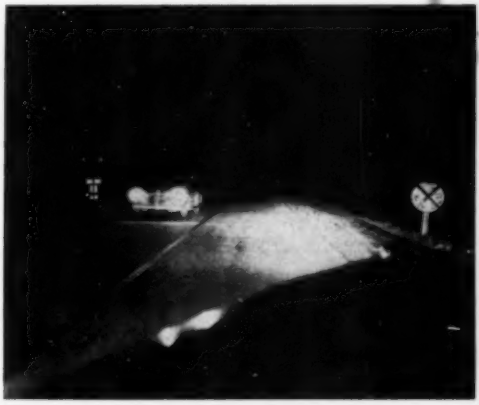

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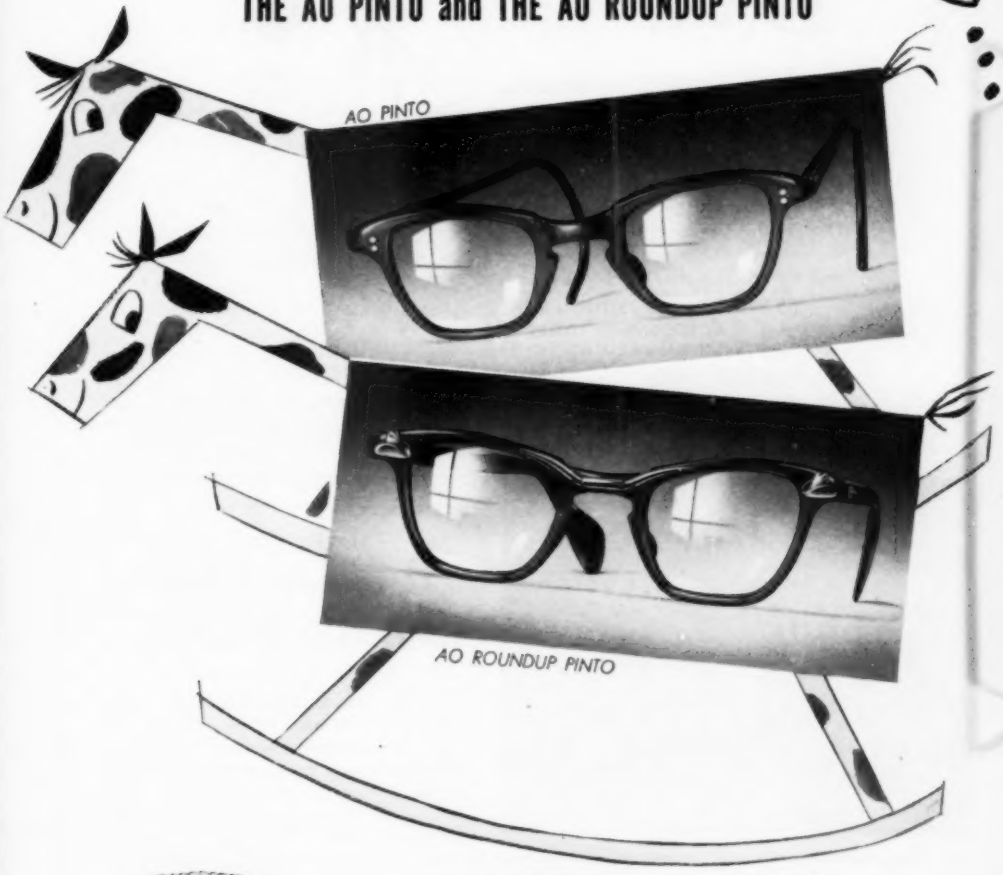

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Vol. 29 August, 1952 No. 8

CLINICAL POINTERS IN STRABISMUS ORTHOPTICS*

William Smith†
Massachusetts College of Optometry
Boston, Massachusetts

The type of orthoptic treatment selected in the management of strabismus is based upon information from the case history and observation of ocular motility as well as from the data obtained from the refractive and orthoptic clinical tests. The extent to which the various objective and subjective clinical tests may be carried out, in some instances, and their reliability, must be given consideration because it is of significance when it pertains to treatment. It is a known fact that in many cases, especially the very young squinter,** it is impossible to perform all the clinical tests desired. Even some which are considered highly essential may have to be left undone, at least during the first examination. Even though it is desirable, it is not always possible to perform an examination in which every test is accurate to the minutest detail. Nor is it possible or even necessary to perform every orthoptic test in the manual as a prerequisite for determining the type of treatment, its extent, or the possible prognosis of a case. True, it is most desirable to have as complete a record as possible, but not having it should be no deterrent in the management of strabismus. However, this is not intended to imply that tests and findings from tests are unimportant, or even that they have limited value, and, therefore, can be disregarded. No such inference is intended. Nevertheless, there are several factors which must be known because of their utmost clinical importance and direct bearing and for which tests must be made. Without knowing the results of these, no treatment of a case can be undertaken or considered. These are:

*Read before the annual meeting of the American Academy of Optometry, New York, New York, December 9, 1951. For publication in the August, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Optometrist. Member of faculty. Fellow, American Academy of Optometry.
**And the younger the age at which treatment is started the more promising is the prognosis—though age, as such, is not so much a factor as is generally believed.

a. Determination if there is visual perception, and, if possible, the quantity of visual acuity.

b. Type of ocular motility.

c. Type of muscle defect and probable complications.

d. Determination if there are vicarious muscular and visual conditions or other functions of a compensatory nature. For example, head tilting and face turning.

e. Refractive state of the eyes and the effect of ophthalmic correction on an existing anomaly. Internal and external examination of the eyes are part of this phase.

The case history forms the groundwork, and if properly taken, can give clue to the performance of many functions for which no tests can at the moment be made. It is to the examiner's advantage to know the status of binocular perception and type of binocularity, the type and quality of retinal and proprioceptive projection and spatial relationship, and the type of retinal correspondence. However, if tests for determining these functions cannot be performed, treatment can nonetheless be started and the tests done at subsequent times. In most instances, it is possible to draw conclusions as to the status of these functions from other, simpler tests, in which even the youngest child can partake, and from the nature of the defect, or from external observation and the case history.

Observation of the motility, especially that of the predominately affected eye alone, and of both eyes together in conjugate action, is an important factor both from the standpoint of diagnosis and in the impending treatment. Vertical and oblique muscle defects, especially of low degree, are often hidden or masked by vicarious postural adjustments, of which torticollis* and face turning are the most common manifestations. For these reasons such defects go unnoticed or/and remain uncorrected because they are not readily recognized. The fault in most instances lies with the method used for testing and is more likely to occur when testing is done with stereoscopic type instruments and their respective targets. Hence, it is important to be especially careful in observing performance of the monocular and binocular movements in elevation and depression, and in the various oblique positions of gaze, by the examiner raising both lids and watching the patient's eyes as they move in various positions of regard. The performance of such

*There are three recognized types torticollis (head tilt); ocular, neurological, and orthopedic. The ocular type results from paresis of one of the vertically acting ocular muscles and is an attempt by the individual to compensate for both the vertical and torsional components of the tendency to deviation. Head tilt is more common in palsies of the obliques than of the vertical recti muscles.

ocular motility can be determined much more adequately and in a very simple manner without the use of any instrumentation. Serious discrepancies are often encountered when reliance is put on instrumentive tests alone.

To determine by observation muscle action in the straight downward, down and in, and down and out positions, both upper lids are drawn up with the thumb and index finger of one hand and held taut, while both eyes simultaneously are directed to fixate in the positions desired to the limit of their ability. Quality of binocular alignment is thus observed. If a defect of vertically acting muscles exists, it can be readily determined by the relative alignment of the iris margins. Muscle action in elevation (straight up) and the movements up and in, and up and out respectively, can be examined in a like manner, only here it is not necessary to manipulate the lids, and the limbus of each eye continues to serve as the criterion for aligning. It is not unusual for me to see clinical case reports of patients whose vertical muscle balance is recorded as isophoria or orthophoria, when tested with the stereoscopic instruments, and Wells, Keystone and other similar targets, as well as with the major amblyoscopes and their respective targets. But when muscle function is evaluated by observation, a marked discrepancy in the binocular vertical alignment may be found to exist. In all such cases, the only manifest symptoms may be presence of a head tilt and turning of the face, mention of which does not even appear in the records available. These symptoms of vicarious postural adjustment prompts me to search for possible causative or contributing factors. Presence of vertical muscle anomalies may be later confirmed by tests on the Maddox tangent scale with the Maddox rod, producing dissociation. This may be further confirmed by the displacing prism test with a narrow band of light at 20 feet as the fixation target. The explanation for this is quite simple. The stereoscopic instruments limit fixation to the primary, straight ahead position primarily. However, defects of the vertical recti are invariably manifested in the field of action of the affected muscles. In these, the primary function is that of elevation and depression, with intorsion and extorsion being secondary manifestations. Therefore, defects can be more readily discovered only when complete dissociation is produced and when the fixation target is situated in a large, unrestricted fixation area. Because of their restricted fields, stereoscopic instruments are too confining for accurate determination of vertical muscle functions. They are even more so confining when the obliques are studied. The primary function of the superior and inferior obliques is intorsion and extorsion, respectively.

It must be remembered that ocular torticollis and face turning, as distinct from the other types torticollis and face turning, invariably are probable indications of a compensatory reflex action. This the visual apparatus acquires in an attempt to establish and maintain some form of binocular alignment, even if it is at the expense of postural maladjustment. It can be clinically demonstrated that when the vicarious positioning of the head and face is forcibly eliminated, or corrected, but without providing an alternate compensatory adjustment, the reaction invariably is visual discomfort. I have seen instances in which the patient, having earlier demonstrated binocular alignment and even fusion on stereoscopic targets by tilting his head and turning his face, loses all this when the examiner forcibly straightens the patient's head and face.

A highly important factor which should be given equally due consideration in the management of strabismus by orthoptics either as a specific procedure or as a supplement to surgery, is the full realization of the extent to which deterioration of the various components of visual perception is possible. This loss of function is not confined to visual acuity alone, or to fusion. It is known to encompass every phase of visual performance, and it is not always possible to detect such anomalies entirely by instrumentive tests. This may be due to the limitations in the testing apparatus, to compensatory face and head adjustment, or to both. Those practitioners who have better than average knowledge of the visual apparatus and all its aspects and ramifications, can fully appreciate the value of complete understanding of a case as it appertains to its management.

Having determined the nature of an existing defect and the probable complications, and having evaluated and correlated all the findings, the next step consists of outlining the plan of treatment. If the treatment is to be entirely by orthoptics, then such a plan becomes an integral part of the record and in a sequential step by step arrangement serves as a guide during the entire period of treatment. It is important that the outline is complete in that it takes in all the steps both primary and advanced. This does not mean that because of such completeness every step in the procedure is to be given during each session. The plan, or outline, is merely a blueprint of clinical performance.

The sequential arrangement of the various component steps in the procedure depends on the specific case. A vital factor is the thoroughness with which each treatment phase is carried out. It is important to remember that in strabismus, there is partial development and/or complete under-development of perceptual functions which must, in many

instances, be established and developed, or reconditioned to a level considered normal. To be most effective, the primary steps in the treatment procedure must be given persistently and then repeated to a variable extent, even during the advanced stages of treatment. If the treatment contemplated is to be both surgical and orthoptic, then a pre-surgical procedure of orthoptics should be planned as well as that which is to follow surgery.

In dealing with squint, the eyes are in a state of secondary correspondence.* This situation is entirely different in normal binocular alignment. Here, there is normal motor correspondence which is manifested in the correct positioning of the eyeballs. There is also normal retinal correspondence and with it, normal binocular single projection, resulting from corresponding bifoveal stimulation. Normal proprioceptive correspondence in which there is correct postural alignment of the entire body in correlation with the bifoveal line of fixation, is also manifested.

All this is completely changed in squint. Alignment being confined only to the non-squinting eye, produces complete changes in ocular conditioning, in retinal correspondence, and in postural alignment. These normal adjustments are replaced by secondary adjustments of which retinal correspondence is a manifestation and which serves, in reality, as a compensatory function. *Secondary correspondence starts to be manifested as soon as strabismus occurs. It starts with the first incidence of deviation regardless of how transitory it is and with it is manifested the beginning of sensory inhibitions.* This tends to put a different light on the belief in some quarters that some squints become self-corrected and also that surgery alone in all instances is capable of restoring normal binocular functions.**

There are four rudimentary, basic and fundamental steps in the orthoptic treatment of strabismus which the writer considers most important. This is regardless of whether the treatment is used as a specific, or in conjunction with surgery. These steps constitute the

*If by normal correspondence is meant simultaneous impingement of visual stimuli on the fovea of each eye, resulting in a response of bifoveal fixation, then, on the same basis, visual fixation in which stimulation of one eye is foveal, while that of the other is off-foveal, or eccentric, has, what is known as anomalous (abnormal) or secondary retinal correspondence. In the act of simultaneous binocular perception such correspondence is bi-retinal but not bifoveal and is therefore false or incongruous. In such situations, the term *non-correspondence* would be more appropriate and more definitive.

**Hypothetically, this might be so if (a) the strabismic child were to be operated on the very first moment that the deviation occurs, irrespective of how transitory, and (b) that the muscular alignment were so accurate as to instantaneously transfer such alignment to the visual cortex, and (c) that normal bifoveal and motor correspondence prevailed, and (d) that all other sensory functions suffered no interruption.

foundation upon which the various component visual functions are trained and developed. They also serve as a basis for teaching and developing the more advanced visual functions, upon which progress in general is evaluated.

Elimination of suppression is the first requisite. For normal binocular perception, it is imperative that all visual stimuli to the cortical centers are transmitted from corresponding retinal areas along the visual pathways, unobstructed, unhindered, uninterrupted, and uninhibited. Blockage occurring as an inhibitory sensory reflex in the form of central suppression, makes such transmission impossible, with the result that vision continues to be uniocular even in cases where the two eyes are aligned surgically.

From all indications, it is evident that suppression does two things: one, it stops further acquisition and development of vision; and two, if allowed to persist, disuse of the eye may also cause loss of existing vision. According to Adler,[1] suppression may be looked upon as a form of active internal inhibition, brought about because the visual apparatus is presented with a paradoxical situation which is intolerable. Two images are seen instead of one. One of these is a false image and has not a definite spatial localization or relative positioning because it cannot be confirmed by touch as can be the true image. Motor correspondence begins to fail with the first transitory occurrence of ocular deviation, and when that takes place, retinal inhibition coupled with secondary correspondence is being established.

It is known that visual acuity varies greatly in the different parts of the retina. It is keenest at the fovea and diminishes as the periphery is approached. Hence, suppression of the foveal area has to be most intense for that area to become completely inactivated, while that of the periphery can be of moderate extent.* This is exactly how the condition is observed clinically. According to Chavasse[2] and Lyle,[3] the effect of retinal inhibition is to flatten the contour sufficiently to allow the other parts of the retina to achieve a requisite degree of dominance.

If the suppression is uniocular, the inhibition becomes fixed and persistent, and is manifested as amblyopia exanopsia. In alternating suppression, the inhibition is functional but not fixed: that is, shifting from one eye to the other. This type of uniocular contoured inhibition is present only when the other eye is in use. It appears to be a form of

*J. D. Feldman and A. F. Taylor (Obstacles in Squint Training—Amblyopia. Arch. Ophthal. 27-851-868, May, 1942) state: "The incidence of scotomas among our amblyopia patients was not as high as that often mentioned in the literature. Suppression areas, however, were common. These areas are not always constant and may be found associated with squint without amblyopia."

inhibition induced or conditioned by the use of alternate eyes. Clinically this indicates that in strabismus, suppression is manifested when simultaneous binocular vision is attempted. Amblyopia, on the other hand, is a non-conditioned or functional loss of visual acuity which persists whether one or both eyes are being used. *All indications point to it as being the end result of uniocular suppression.*

According to Ludvigh,[4] Wald and Burian,[5] among other investigators, and a fact which has been rather well known to those dealing with the subject, the only function which is grossly affected in amblyopia is the perception of form vision. All other functions are said to be unaffected both in the foveal and peripheral areas. This includes color vision and dark adaptation, with the absolute threshold being no different from that of normal eyes. The above assertion and other evidence point rather strongly to the belief that amblyopia is not a *retinal* defect, but *that the site of interference is in the cortex.* Moreover, it is known that pattern vision is completely separated functionally from light perception and spatial perception and that it occupies a higher level than light perception. Amblyopia from strabismus, then, is probably due to inhibition of the higher cortical function of pattern vision, without notable impairment of the lower cortical functions of simple light perception and spatial localization.*

In view of all this, elimination of suppression, and with it amblyopia, is the very first of the four steps referred to at the beginning of this presentation. The methods that I use are those described minutely in my book.[6] They consist of:

(a) Retinal stimulation.

(b) Training of visual orientation.

(c) Stimulation and development of macular-foveal perception.

The primary objective of these three steps is reactivation and rehabilitation (and readaptation) of the visual reflex arc. This arc may be defined as a pathway in the field of binocular visual perception for the reception, conduction and recognition of visual sensations. There is ample clinical evidence to prove that in strabismus the visual reflex arc (like all other binocular functions) is anomalous. It seems, therefore, that in order to help restore normal functioning, only such elements can be used to which the visual apparatus will respond. And light is such a medium. Repeated and persistent stimulation with flashing light tends to restore the function of the visual pathways, helps to eliminate

*Experiments on animals have shown that complete removal of the occipital lobes results in virtually complete loss of form and object vision, but with little if any observable loss of light reaction or brightness discrimination. However, similar destruction of the occipital lobes in man results in complete and permanent blindness.

existing blocks and to reestablish binocular and bifoveal perception.

One purpose of retinal stimulation with light is to help establish a pathway for the conduction of external impulses which proceed from the retina toward the cerebral center. Another is to help establish a basis for normal uniocular functions which are necessary for the eventual development of congruous, and if possible, normal binocular perception. Such normal functions as foveal fixation, spatial direction, localization and projection, which tend to become lost or deteriorated from non-use, become that way through the inhibitory process known as suppression. Instruments for giving retinal stimulation can be readily improvised or constructed. A goose-neck lamp having a parabolic reflector, a 15-watt frosted bulb, and a flashing device, can be used effectively to provide such stimulation. With this device, only one eye at a time can be stimulated. The instrument which I am using (Figure 1), was

Fig. 1. Side view of author's instrument for retinal stimulation.

constructed from two small metal cans joined together and each wired with an electric light socket and a separate wire and cut-off switch. Both these cans are attached to a Keystone telebinocular head from which the lenses are removed. They are attached in such a manner as to permit removal or detachment of each can whenever necessary. This combination is mounted on a rigid, adjustable stand. Such an arrangement provides two separate dark chambers in front of two intense light sources. This apparatus provides means for giving retinal stimulation either to one eye alone or to both together as required.

The patient is seated at the instrument described, or one improvised for the purpose, and the flashing light is arranged so as to flash directly into the affected eye: the one not stimulated is completely occluded. When using my instrument, the patient's face is as close as possible to the eyepieces, but when a flashing device is improvised from a goose-neck or other type lamp, its proximity to the subject is a matter of individual need.

Retinal stimulation is no longer indicated when there is complaint of the light becoming excessively bright and there is lacrimation. Retinal stimulation is merely one step, but a very important one, in the process of eliminating suppression and all attendant complications arising therefrom. The usefulness of this single treatment process extends also to teaching and developing visual orientation and macular-foveal fixation. Normal performance of these two functions is lost with the incidence of strabismus and does not become recovered either spontaneously or otherwise when surgery is performed. Recovery is possible only through reconditioning methods such as orthoptics. Development of the two closely linked afore-mentioned processes of perception is of utmost importance in order to make elimination of suppression most effective and lastingly complete.

Here visual orientation denotes the ability to adjust oneself visually and perceptually to localizing objects in space. Inability to do this is a common occurrence in cases of extremely high amblyopia, when the amblyopic eye alone is being used while the other is occluded. Spatial relationship is awry and there is absence of sensorial positioning. Where debility of visual orientation exists, the main processes in the treatment is to develop and enhance the functions of recognition, direction, spatial projection and association, and to make these functions fixed and retentive. All these functions are necessary to the establishment of qualitative and quantitative visual perception. And therefore, the difference between success and failure of a case actually depends upon the extent to which they are developed.

To teach visual orientation, any stereoscopic-type instrument can be used quite adequately. The targets can be any number and variety of tachistoscopic, stereoscopic, Keystone type stereometric, and other type targets having a wide assortment of varied-size objects and characters, either letters, pictures or geometric forms. Targets of a type appearing on page 61 of my book,[6] can be very useful in the early training of visual orientation.

Development of macular-foveal sensitivity starts with retinal stimulation. Adding tracing to the retinal stimulation phase, and at the

same time seeing to it that correct postural alignment is maintained, helps further in developing and normalizing macular-foveal fixation and proprioceptive adjustment. An instrument such as the flashing box is very useful for this type of combined stimulation in one process of tracing and retinal stimulation.* Indirectly, it provides a means for retinal stimulation. Directly, it tends to stimulate the functions of foveal fixation and projection. An important factor is that this can all be carried on even after direct retinal stimulation becomes no longer tolerable.

I shall not venture to say as to what physiological or physio-psychological changes are produced by retinal stimulation of the types described. However, based on clinical experience, I can definitely state that those cases in which such stimulation is omitted, the progress is not as good or as rapid as it is in cases which receive it. Furthermore, on the same basis — *watching carefully to determine how the eyes react convinced me of the efficacy of this single step in the procedure. In every case the eye thus stimulated turned toward the flashing light as if by reflex action, irrespective of its original position.*

And, furthermore, basing responses on the aforementioned experience, it can be stated that the steps already described and those following, if carried out repetitiously with utmost care, diligence and persistence, *tend to eliminate existing anomalies of fixation, projection and retinal correspondence and at no time do they cause onset, development and possible intensification or re-enforcement of such anomalies if already present.* I cannot emphasize enough the fact that the main purpose and objective of these four primary steps is to *try to prevent development of pseudo-macula, or to eliminate it, if present, and all other eccentric visual habits,* acquired since the incidence of squint.

The third of the four steps deals with teaching and developing normal sensory perception. As already stated, in strabismus it is imperative to eliminate suppression which prevents one eye from taking part with the other in the normal act of binocular vision.

As suppression becomes eliminated, it is concurrently necessary to establish, teach and develop normal bifoveal correspondence and to make such functional performance habitual. Such development also encompasses to some extent peri-macular correspondence. This is *doubly important in cases where abnormal retinal correspondence is found to exist.* With properly applied methods, these abnormally developed functions *are trainable.* Training of projection, both retinal and proprioceptive, comes within the scope of this step. Retinal projection de-

*Tracing is done with the hand habitually used.

pends on the position of the retinal points in relation to the visual line and the object of fixation. Proprioceptive adjustment and fixation is necessary in many instances to help correct retinal projection. This is accomplished by the oculo-motor system. In actual clinical application, both phases are interdependent and inseparable.

Two of the corrective steps discussed earlier in this presentation—those of retinal stimulation and tracing, are of inestimable help in the primary training for developing spatial projection. Development of directional fixation, like that of sensory projection generally, is dependent upon elimination of suppression and the establishment of a normal path of binocular conduction. In all these, the basis is normal retinal correspondence. This may be accomplished by repeated and persistent stimulation of the macular-foveal area, while concurrently trying to eliminate acquired vicarious visual and postural habits. This is accomplished most effectively by using the projection training plates shown in Figure 2 at right.

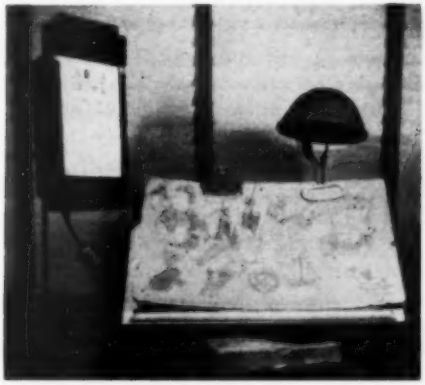

Fig. 2. At right, author's projection training plates. At left, author's improvisation of Peckham's Visual Acuity Training Flashing Box.

These plates[6] I developed for teaching and training foveal, directional, and proprioceptive fixation and projection. They consist of simple multi-colored drawings of individual pictures and composite scenes of familiar objects, on heavy cardboard about 15 x 19 inches in size. Very small holes are punctured in each of these pictures in profusion and at random. Location of these holes need not follow any definite arrangement, as long as they are included within the confines of each respective picture. Colored toothpicks, preferably, are used in

conjunction with these plates. The chart is well illuminated and placed at an angle of 45° on a sturdy easel. The better eye is occluded. The patient is instructed to insert toothpicks, one at a time, into holes of a specific picture. This must be done by projecting them by aiming or fixating. No head tilting or face turning is permitted. The aiming must be direct. If fixation is misdirected, which is often the case, the task is repeated again and again until performance becomes easy and accurate.

The toothpicks are taken out one by one in precisely the same manner as they are inserted, by reaching for the points. It is not uncommon at the beginning for the patient to reach for a toothpick and misdirect distance and misjudge position. Past-pointing, especially, is more prevalent during this phase than on inserting. It indicates that sensory relationship is lacking. Repeated performance of this task helps to develop normal sensory relationship, and at the same time aids in developing and maintaining postural adjustment. In cases of alternating suppression, the patient is required to insert the toothpicks with one eye covered and remove them with the alternate eye covered. All training is at the near point.*

Thus retinal and proprioceptive fixation is used in conditioning the sensory relationship which we know as spatial projection and to which Lyle[3] refers "as the reaction of the individual to the direction of an object."

The last and fourth step which is of equally great importance as the others, is the development of visual acuity. While the improvement here must encompass every phase and every level of visual perception, the emphasis must nevertheless be placed on qualitative as well as on quantitative visual perception. Under "quantitative" development is meant the development of visual acuity at all distances, all areas, and to the highest possible levels of recognition.

Qualitative visual perception comprises the preceding and also the faculties of visual discrimination and refinement. Speed of perception and span of visual recognition also belong in this category.

There are many methods available for training and developing visual acuity in all the phases mentioned. Irrespective of which method is used, the primary aim is to improve sight to the highest level possible and to keep it so. Snellen charts can be used. Then there are specially designed visual acuity training targets for some of the stereoscopic type instruments. For training near vision, books with varying size type, Jaeger type charts and targets by Betts, Grey and others, for stereoscopic type instruments, are available. My improvisation of the Peckham

*As in tracing, the hand habitually used is also used here.

visual acuity flashing box, Figure 2 at left, is very useful for training visual acuity at varying distances.

The four steps described constitute the foundation upon which all processes concerned with the performance of binocularity are to be built. It is safe to state here *that the extent to which strabismus may be reconditioned and the length of time such improvement may be retained, depends, in a large measure, upon the thoroughness with which these four primary steps are carried out, and how effectively their performance is integrated into the normal visual act. There are no short cuts, nor are there substitutes for hard and strenuous work.* Habit is developed by repetition, and the more intensely it is done, the better are the chances for successful outcome. In cases of squint, it requires an infinite amount of patience and perseverance and a great deal of time to eliminate abnormal visual functions and to teach and develop those which are considered normal. This must be done in order to replace acquired and vicarious visual habits which the squinter invariably and unwittingly develops in the course of learning to see. From the biological standpoint, the process "learning to see" goes on regardless of whether the acquired processes are normal or abnormal. However, it is difficult to say which step in the procedure is the more important. Each one is dependent on the others. It is important to remember that throughout the entire procedure, persistent, though not necessarily lengthy, repetition tends to facilitate performance. Added to those four steps, interim lengthy periods of occlusion of the better eye, further tend to help restore visual and perceptual functions. Such occlusion can be for periods ranging from one to six weeks, or longer, at one time, without producing deleterious effect.[6, 7]

As the primary visual functions become habitually integrated and fixed, training and developing of the more advanced phases of binocular perception is added. In the process of conditioning, it is necessary first to establish a firm foundation before attempting to develop the more advanced levels of functional performance.

CONCLUSION

Since it has become known that the faculty of seeing belongs in the category of "learned" or "conditioned" functions and that the visual apparatus at birth is functionally in a semi-developed state, the subject of strabismus and the problems relative to its correction have assumed different proportions, different meanings. While development of normal binocularity is the chief aim and ultimate goal, it is necessary first of all to lay a firm foundation for training, developing and integrating the various component elements concerned with seeing. The first step

making up this foundation consists of processes for establishing all sensory functions. This includes elimination of central suppression, thus helping to establish connection between the two eyes. Reactivating the visual pathways and removing sensory blocks, which in many instances, are of long standing and deep-rooted, is of vital importance before attempting to teach and develop bifoveal and binocular perception. This makes the matter of age a very important factor. Experience has taught me that the earlier the age at which preventive-corrective care is started, the more favorable the prognosis. On the same basis it might be asserted that there is no definite age level for orthoptic treatment.

All the treatment procedures described, with the exception of projection, can be given on any type of apparatus at the practitioner's disposal or without any special apparatus. What I am attempting to present is a tried and proven method of clinical procedure.

Optometrists must learn to accept the fact that it is not possible in every instance to attain complete amelioration. When this is the case, partial improvement is still better than no improvement at all. The surgeon knows this fact when the results of his work produce only cosmetic improvement.

New ideas and techniques, especially those pertaining to the healing arts, are not very readily accepted. There are some exceptions, but the vast majority of practitioners tend to be followers and prefer to wait for a word from those who, at the moment, they hold as acknowledged authorities.

But then, it was Nicholson[8] who said: "When a tradition once becomes established by the hall-mark of acknowledged authority, it takes more than cold fact to uproot it from men's minds—it takes time."

80 BOYLSTON STREET

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THE EFFECT OF ANISEIKONIA ON THE AMPLITUDE OF VERTICAL DIVERGENCE*

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INTRODUCTION

One of the common clinical signs of aniseikonia reported by investigators is impaired fusion.[1, 2, 3] In any given case, this impairment may be manifest by poor stereopsis, reduced amplitudes of fusional movements, or by partial or total suppression of the ocular image of one eye.[4] In an investigation of aniseikonia, usually attention has been given to the presence or absence of one or more of these findings and the inference made that the aniseikonia was the cause of the absence or loss. While this approach is certainly valid and necessary in clinical studies, it leaves much to be desired for a complete understanding of the impairment resulting from the anomaly. Fortunately, in aniseikonia it is possible to alter the sizes of the ocular images by various means. Also, techniques and methods are available so that stereoscopic sensitivity, amplitudes of fusional movements and the extent of suppressions can be accurately and quantitatively studied. Consequently, it is possible to investigate the effect of aniseikonia upon one or more of these functions by the use of subjects who have normal or better than normal performance in the absence of an induced condition.

In a previous publication, a method was described which permits an accurate measure of the amplitude of vertical divergence.[5] This method necessitates an introduction of vertical disparity in steps of 0.25° per two-minute interval. To measure accurately the response of the eyes, monocular point of light targets can be aligned. With this method it is possible to measure the extent of vertical divergence to within ±0.10°.‡

The effect of aniseikonia on the amplitudes of vertical divergence, using targets consisting of one or more uniformly illuminated circular

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‡In design, the apparatus is similar to a Wheatstone stereoscope with the targets located 3 M. from the entrance pupils of the eyes. For a complete description cf. reference 5.

disks on black backgrounds with the method described above, has already been reported in the literature. Briefly, the experiments and results of these investigations are as follows: in one series of experiments the target for the two eyes consisted of one, three and five disks which were 0.25° in size. The separation between any two disks was 1 degree. When more than one disk was used, they were linearly arranged in a vertical direction. The amplitudes of vertical divergence were determined for each of the three types of targets. In each experiment, the center disk of the target was fixated: it was located in the straight forward position of the lines of sight. The size of the targets for the right eye was then made larger in steps of 0.25 per cent and the fusional amplitudes determined.

Representative results of the effect on the different types and sizes of targets on the fusional amplitudes are given in Figure 1A. These definitely show the importance of the peripheral stimuli with a difference in angular magnification of the retinal images. In fact, the results indicate that the number of peripheral stimuli is not as important as the location of the stimuli with respect to the fovea. To further investigate this factor, the effects on the fusional amplitudes of the separation of three disks in the targets were determined. As in the previous experiments, the amplitudes were measured when the targets were equal in size, and also when the target for the right eye was increased 25 and 50 per cent in size. Typical results are given in Figure 1B. The num-

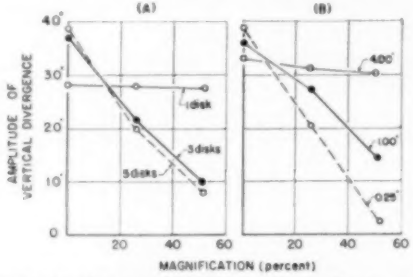

Fig. 1. Illustration of the effect of aniseikonia on the amplitudes of vertical divergence using one, three, and five disks as targets. In 1B, the separation of three linearly aligned disks were varied and the effect of aniseikonia determined.

bers adjacent to each curve are the separations of the disks in the target for the left eye. One can observe that the effect of a difference in the relative magnifications of the retinal images principally depends upon the location of the peripheral stimuli. This effect varies inversely with the distance of the stimuli from the fovea.

Although the results described above are of fundamental importance so far as the nature of the fusional movements are concerned, they do not answer the problem encountered in the clinical practice of aniseikonia. For example, patients rarely encounter stimulus situations as simple as those described above. On the contrary, they invariably are complex patterns consisting of a multitude of small detail. Further, the impairment of the fusional movements with the disk targets, even with an aniseikonia of 10 per cent, cannot be considered clinically significant. It is important to note that ordinarily binocular vision only can be maintained with difficulty, if at all, where the aniseikonia exceeds 5 per cent. For these reasons, an investigation was undertaken to determine the effect of aniseikonia on the fusional movements using targets of printed lines of words of varying sizes. This paper is a report of this investigation.

APPARATUS

A schematic illustration of the apparatus used in the investigation is shown in Figure 2. The essential components consisted of a fore-

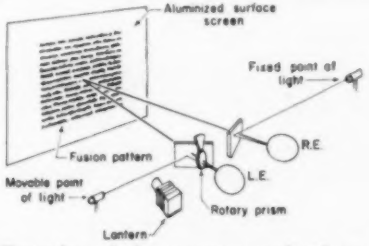

Fig. 2. Schematic illustration of the apparatus employed to study the effect of aniseikonia on the amplitudes of vertical divergence.

head rest to which was mounted two half-silvered mirrors, and a rotary prism, a projector and screen, and two points of light sources. The screen was aluminized and two meters square in size; the center of the screen was the same height as the center of the lens cells before the subjects' eyes, namely 125 cm. It was oriented perpendicular to the median sagittal plane of the subjects' head and located 3 meters from the eyes. The projector was a Model D Dilineascope manufactured by the Spencer Lens Company; for all the experiments the projector was equipped with a 16.25 mm. projection lens and a regular 200 watt projection bulb.

Figure 3 illustrates the detail of the forehead rest, rotary prism and mount for the mirrors. The mirrors were front silvered to provide exactly 50 per cent reflection and transmission.

In order to introduce vertical disparity of the images, a Risely rotary prism was used before the left eye. The rotary prism employed in the experiments was designed to produce a maximum of 3.5° of deviation when the bases of the prisms were in the same direction and the base-apex lines aligned. To increase the accuracy of settings of the rotary prism, an enlarged scale and pointer were used. These can be seen in Figure 3. With this device, it was possible to make settings of 0.25° with an accuracy of ±0.05°.

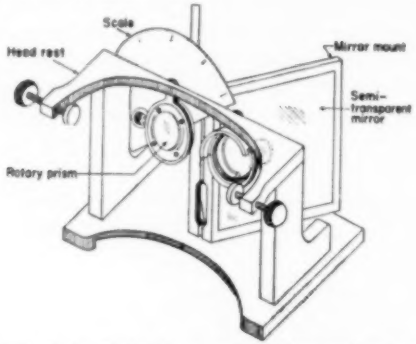

Fig. 3. Detail sketch of the forehead rest, rotary prism and mount for the mirrors.

The mount for the rotary prism provided the limiting aperture for the binocular field of view. The angular size of this field was 30 degrees.

In order to measure the response of the eyes to a disparity the subject horizontally aligned the point-of-light sources. The point-of-light source visible to the right eye was kept at a fixed position. The point for the left eye was adjustable vertically; this was accomplished by mounting the point of light source on a trolley which was movable on an optical bench. A scale affixed to one rod of the optical bench and a pointer on the scale mounted to the trolley permitted the position of the point-of-light source to be read with an accuracy of ±1 millimeter. Provisions were made so that the subject could accurately adjust the position of this source. The distance of both the fixed and movable source was 3 meters from the subjects' eyes. The one visible to the right eye was seen 4° to the left of the fixation point and in horizontal alignment with it. The one seen by the left eye was seen 4° to the left of the one seen by the right eye or 8° to the left of the fixation point.

The backgrounds for the screen and point sources consisted of large flat black surfaces on which no detail was visible. During an experi-

ment the projector was carefully shielded so that the stray light from the screen was the only source of illumination in the laboratory during the course of an experiment. All pieces of apparatus including the head rest and mirror mounts were painted a flat black to minimize reflection.

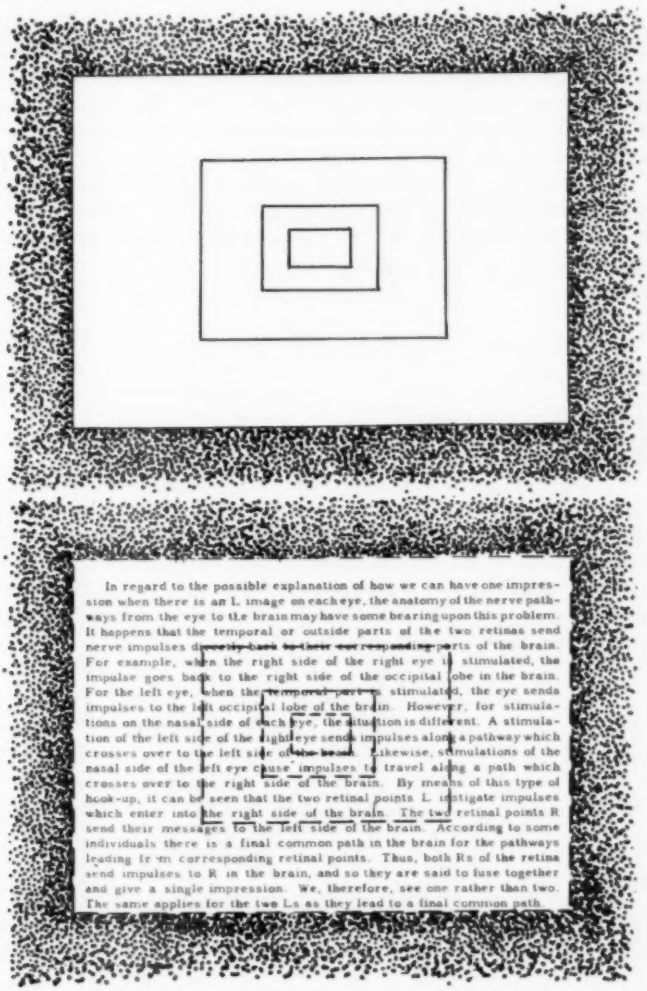
In regard to the possible explanation of how we can have one impression when there is an L image on each eye, the anatomy of the nerve pathways from the eye to the brain may have some bearing upon this problem. It happens that the temporal or outside parts of the two retinas send nerve impulses directly back to their corresponding parts of the brain. For example, when the right side of the right eye is stimulated, the impulse goes back to the right side of the occipital lobe in the brain. For the left eye, when the temporal part is stimulated, the eye sends impulses to the left occipital lobe of the brain. However, for stimulations on the nasal side of each eye, the situation is different. A stimulation of the left side of the right eye sends impulses along a pathway which crosses over to the left side of the brain. Likewise, stimulations of the nasal side of the left eye cause impulses to travel along a path which crosses over to the right side of the brain. By means of this type of hook-up, it can be seen that the two retinal points L instigate impulses which enter into the right side of the brain. The two retinal points R send their messages to the left side of the brain. According to some individuals there is a final common path in the brain for the pathways leading from corresponding retinal points. Thus, both Rs of the retina send impulses to R in the brain, and so they are said to fuse together and give a single impression. We, therefore, see one rather than two. The same applies for the two Ls as they lead to a final common path.

Fig. 4. Two types of targets used in the investigation.

PROCEDURE

It has been shown that the rate at which a disparity of the images is produced will effect the resulting amplitude of vertical divergence.[5] Further, it is known that the effect of vertical divergence in one direction will effect the divergence that can be induced in the opposite direction if the tests are not separated by a period of time. This effect is maximal if the two tests immediately follow one another and decreases with an increase in the length of time separating the tests. For this reason, an interval of two hours was always provided in the measurement of the positive and negative vertical divergences.

In measuring the amplitude in a given direction, the vertical disparity was introduced at the rate of 0.25° per two-minute interval. All measurements were made within the last 30 seconds of this interval. By this procedure the subject fixated the target with a given disparity for one minute and a half before any attempt was made to align the measuring points.

For each 0.25° of disparity the subject made five settings of the measuring points. For all the curves illustrating the response of the eyes to the disparity presented in the next section, an average value of the five settings was used.

RESULTS

Essentially, there were only three types of stimulus patterns employed in this investigation. Two of these are illustrated in Figure 4. The angular size of the largest pattern measured at the entrance pupil of the eye was 17° x 12.4°; the angular size of the next smaller pattern was ½ of these values. This same ratio was used for each succeeding smaller pattern; thus the ratios or the areas of the patterns relative to the largest size as 1 are 0.25, 0.0625 and 0.016.

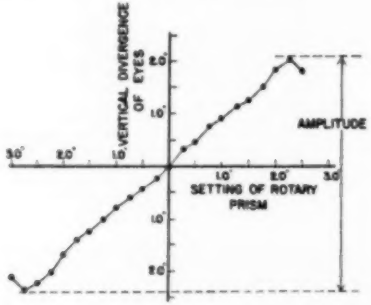

Fig. 5. Illustration of the method used to determine the amplitude of vertical divergence.

A small black disk at the center of the target was visible continuously to both eyes and measured 0.30° in angular size. It served as a fixation point during all the experiments.

The third type of pattern was a duplicate of those shown in Figure 4, except that the letters were white and background black. With this arrangement there was no border between the background for the letters and the area surrounding the background.

An illustration of the method employed to determine the amplitude of vertical divergence for any given test situation is given in Figure 5. As pointed out previously, each point on the curve is an average of five settings of the movable measuring point.

One of the results of this investigation is that the effect of aniseikonia varies with the size of the stimulus pattern. However, the amplitude also varies with the size of the stimulus pattern in the absence of an aniseikonia. For this reason, consideration first will be given to this variable.

TABLE 1.

Subject	Angular Size of Target, (degrees)	Target Uniform Lines of Black Print on White Background With Border		Target Uniform White Area With Border		Target Uniform Lines of White Print on Black Background Without Border	
		Amplitude	*Average*	*Amplitude*	*Average*	*Amplitude*	*Average*
L.P.	17x12.4	*6.94 7.61	7.27	*6.20 7.56 6.79	6.85	*6.46 (1) 8.41 (8)	7.44
	8.5x6.2	*6.18 7.30	6.74	*6.91 6.83	6.87	*6.82 (2) 7.93 (7)	7.35
	4.25x3.1	*6.75 7.08 7.20	7.01	*5.18 5.19	5.18	*7.41 (3) 7.70 (6)	7.55
	2.12x1.55	*6.20 6.62	6.41	*5.25 5.50	5.37	*7.51 (4) 7.60 (5)	7.55
V.E.	17x12.4	*7.00 6.30	6.65	*4.70 5.48	5.09	*6.20 6.28	6.24
	8.5x6.2	*5.60 5.52	5.56	*4.98 4.60	4.77	*6.02 5.50	5.76
	4.25x3.1	*5.03 4.51	4.77	*2.50 3.35	2.92	*4.91 4.62	4.76
	2.12x1.55	*4.07 4.21	4.14	*2.68 2.85	2.76	*4.28 3.83	4.05
B.B.	17x12.4	*4.30 5.57	4.94	*4.35 5.01	4.68	*5.13 4.34	4.74
	8.5x6.2	*3.30 4.25	3.78	*3.92 4.23	4.07	*4.14 4.60	4.37
	4.25x3.1	*2.75 3.60	3.18	*2.70 3.69	3.19	*4.21 4.12	4.17
	2.12x1.55	*2.85 3.92 3.13	3.30	*2.61 3.08	2.84	*3.00 3.50	3.25

In Table 1 are presented the results of three subjects for the three different stimulus patterns. All three subjects were skilled observers but with varying experience with this type of experiment.

To test the repeatability of the data, experiments were frequently done a number of times. These data are included in Table 1: in every case the asterisks indicate the first data obtained for a given test situation. Proof of the fact that a training influence is present appears in the data of L. P. for the pattern of white print on a black background. The numbers in brackets to the left of each finding indicate the position in sequence of the individual experiment. It is significant that this training effect was not as evident with the other types of patterns. In sequence, the group of experiments with the white print on the black background followed the groups of experiments with the two other stimulus patterns. Subject B. B. also demonstrates the effect of training. Subject V. E. was the most experienced of the three and, in general, his findings show the highest repeatability.

The data of the experiments with the black print on the white background clearly indicated that the amplitude varies with the size of the stimulus pattern. This effect is least for Subject L. P. and approximately the same for the other two subjects.

In an attempt to determine the specific effectivity of only the border and only the print on inducing fusional movements, the experiments with the uniform white area with border and the ones with white print and black background were performed. The data show that the presence of the border does not add significantly to that obtainable without the border. This indicates that there is a limit to which one can increase the effectiveness of the stimulus pattern. It is interesting that large amplitudes can be obtained with only borders located considerably in the periphery of the retinas.

The full significance of the data presented in Table 1 becomes evident when consideration is given to the effect of aniseikonia with the various stimulus patterns. This effect was investigated using the three different stimulus patterns in the four different sizes. The aniseikonia condition was produced by the use of an over-all size lens of 5% and/or an adjustable magnification unit set to produce 5% magnification. By this means an over-all aniseikonia up to 10% could be produced. In every case the size lens and unit were mounted before the right eye.

Since binocular vision usually is not found if an aniseikonia exceeds 5% it was decided to limit the investigation to two different amounts of artificially produced aniseikonia, namely 5% and 10%.

As the data presented in Table 2 illustrate, this choice was adequate.

In Table 2, the data for the white print on the black background are listed in the row "print only." The row "print and border" refers to the black print on the white background with the border between the background and surrounding area.

From a study of the data in Table 2, it is apparent that the greatest effect of aniseikonia is with the largest of the four patterns for all three types. Roughly, for the target whose angular size is 17 x 12.4°, the amplitude is reduced to ½ of its original value for an aniseikonia of 10%. For the pattern of 2.12° x 1.55° the amplitude is reduced only about 1/10.

Although the data clearly show that the amplitude of vertical divergence decreases with an increase of aniseikonia, it needs to be pointed out that this decrease is not constant. The greatest decrease is between 5% and 10%.

That the amplitudes obtained with the stimulus pattern consisting of only the border with an aniseikonia is different than that secured with only the print is evident from the data. In fact, with only the border the effect of the aniseikonia appears to be proportional to its magnitude. With only the print, the decrease in the amplitude from 0 to 5% is considerably less than this proportion. Since the data for the print only and print and border are essentially similar, it can be inferred that the border has little or no effect on the amplitude in the presence of the print.

Some observations of the subjects as well as their subjective impressions during the course of the experiments with the aniseikonia conditions are worthy of note. The most striking of these is produced by binocular rivalry between the printed letters and a background. For example, if a subject with an aniseikonia of 5% views the pattern consisting of black letters on a white background he sees a central area surrounding the point of fixation clearly and distinctly. At a distance from the point of fixation, a band surrounding the clear central zone is seen in which the letters appear to scintillate. Beyond this region, the letters blend off to an imperceptible blur. The size of the clear area varied with the amount of aniseikonia being inversely proportional. All of the subjects reported difficulty in maintaining fusion of the stimulus patterns whenever an aniseikonia was present. This difficulty was evident especially during and immediately following an increase in the prismatic power in the course of an experiment. On numerous occasions, the subjects reported visual fatigue and headaches which were directly attributable to the experiments.

TABLE 2

Angular Size of Target	Target	Subject L.P. Magnification. (Per cent) 0	5	10	Subject V.E. Magnification. (Per cent) 0	5	10	Subject B.B. Magnification. (Per cent) 0	5	10
17° x 12.4°	Print only	8.41	7.41	4.94	6.28	4.99	3.20	5.13	4.03	2.38
	Border only	7.56	5.14	4.08	5.48	3.00	2.09	5.01	3.61	2.22
	Print and Border	7.61	6.73	4.62	7.00	5.37	3.50	5.57	4.23	2.56
8.5° x 6.2°	Print only	7.93	7.28	6.32	6.02	4.21	3.19	4.60	5.03	2.56
	Border only	6.91	5.07	3.98	4.98	3.45	2.42	4.23	2.78	2.03
	Print and Border	7.30	6.34	4.45	5.60	4.70	3.65	4.25	2.72	2.27
4.25° x 3.1°	Print only	7.70	7.35	6.03	4.91	4.13	3.29	4.21	3.66	3.00
	Border only	5.19	4.88	4.35	3.35	2.65	1.68	3.69	2.36	2.14
	Print and Border	7.20	7.17	5.88	5.03	4.78	4.82	3.60	2.95	2.53
2.12° x 1.55°	Print only	7.60	6.95	7.26	4.28	3.75	3.69	3.50	2.50	2.66
	Border only	5.50	5.38	5.35	2.85	2.44	2.15	3.08	2.20	2.37
	Print and Border	6.62	6.10	5.90	4.21	3.37	3.16	3.92	3.06	2.53

DISCUSSION

The fact that the amplitude was found to vary with the size of the stimulus pattern agrees with previous published data which indicated that fusional movements could be induced by peripheral as well as foveal stimuli. Providing that the images for the two eyes are equal in size

Fig. 6-A.

That no essential difference in the results was secured by the different positions of the measuring points is important from several points of view. First, it indicates that the cyclofusional targets employed in the experiments are adequate and do not permit torsional rotations of the eyes. If the torsional position of the eyes had been different in the two experiments, the one curve would have been displaced relative to the second. The finding that the amplitudes of vertical divergence were comparable indicates that rapid, small voluntary movements did not affect the relative divergence of the eyes. However, a generalization of this result for locations of the vertical fusional stimuli other than that used in the experiment cannot be made. The reason for this is that a change of fixation displaces the vertical fusional images from corresponding areas in one portion of the retinas to corresponding areas in another. Since stimuli located in the periphery of the retinas cannot induce fusional movements to the same extent as in the fovea, it is possible that change of fixation might affect the measurement of fusional amplitude when the disparate stimuli are located in or near the fovea.

Fig. 6-B.

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Fig. 6A. The linear sizes of the two paragraphs differ by 5 per cent and are centered on the letter I of the bottom line. For Fig. 6B the linear sizes differed 10 per cent.

the data prove that the stimuli in the peripheral areas cooperate and reinforce the inducement of the fusional movements by the foveal stimuli. That this aid and reinforcement reaches a limit is clearly shown by a comparison of the data with the stimulus pattern of only the border and the white print on a black background without a border.

Why is the amplitude of vertical divergence reduced with aniseikonia? To answer this question requires an explanation for the scintillating zone surrounding the clear central area reported by the subjects in these experiments as well as the role of peripheral fusional stimuli which are in conflict with the foveal stimuli.

In order to understand the presence of the scintillating zone one need only to refer to Figure 6A. This figure was produced by a double exposure of photographic paper: the linear size of the paragraphs differ by 5%. In Figure 6B. the linear size differs by 10%. For both figures however. the paragraphs are centered on the letter l of the bottom line. These conditions would be similar to binocular fixation of the letter l with two different amounts of aniseikonia.*

The explanation of the area of scintillation should now be apparent. It is known that Panum's areas are elliptical in shape with a slightly larger dimension in the horizontal meridian.[6] These areas vary in size and increase with the size of the visual angle. If one plots the ratio of the horizontal dimension of these areas to the visual angle as a function of the peripheral angle. the curve given in Figure 7 is obtained. The

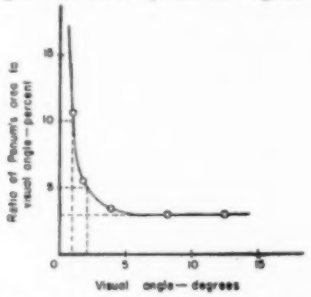

Fig. 7. Plot of the ratio of Panum's areas to the visual angles in per cent as a function of the visual angle in degrees. (From Ogle-Researches in Binocular Vision.)

curve decreases rapidly from the macula to about a visual angle of 4 degrees. and then reaches a nearly constant value of about 3 per cent for visual angles beyond 5 to 6 degrees. Thus beyond 4 degrees Panum's areas are about 3 per cent of the peripheral angle.[6]

*The amount of aniseikonia in per cent magnification of the conditions illustrated in Figs. 6A and 6B varies as a function of the viewing distance. size of print and amount of linear difference in the size of the two paragraphs.

The angular magnification of a size lens or unit is relatively constant for the entire field of view through the lens. Thus, although the disparity with a lens increases with the visual angle, the ratio of the disparity to the visual angle is constant. If such a ratio were to be plotted on a graph as Figure 7, the curves would be straight lines parallel to the abscissa. This actually has been done for size lenses of 3, 5 and 10 per cent: the vertical broken lines indicate the visual angle within which the subject would see a single image. Beyond this region, the subject would either see double images of the print or a rivalry would exist between the black print and white background or two dissimilar lines of print. It is interesting that on the basis of these data the zone of scintillation commences at a visual angle of 6° for an aniseikonia of 5 per cent and 2° for an aniseikonia of 10 per cent.

Whenever the images for the two eyes are sufficiently disparate, dissimilar lines of print at a distance from the fovea may be closer together than similar lines. Since images of dissimilar lines also can induce fusional movements, these stimuli would be in conflict with those resulting from the foveal images.* The valence of these stimuli principally depends upon their distance from the fovea. If the images of dissimilar lines of print overlap as in Figure 6B, the stimulus for a fusional movement would be in the same direction as the foveal image and would constitute a reinforcement.

From the data presented above the explanation of the decrease of the amplitude with an increase in magnitude of the aniseikonia is due to three factors: one, the reduced size of the central area about the point of fixation in which the print is seen clearly and single. Two, an increase in valence of conflicting fusional stimuli with an increase in aniseikonia. For an over-all size difference this occurs in both the horizontal and vertical meridians. Three, a decrease in the distance of the zone of scintillation from the point of fixation. This latter effect probably does not impair the inducement of the fusional movements directly but indirectly by peripheral confusion in the visual field. This makes it difficult to maintain fixation on the area which is seen in single binocular vision.

Appreciation is expressed to Drs. Robert Beattie and Lewis Pugh, optometrists, who participated in the experiments in various capacities and served as subjects.

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SUGGESTIONS FOR A NEW FEE STRUCTURE IN OPTOMETRY*

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PART II‡

REVIEW

In Part I of this report, the writer proposed a simplified fee system for optometrists in professional practice. In brief, this system consisted of (1) the establishment of a minimum examination and refraction fee of $10.00. This minimum would be increased in cases requiring specialized or unusual refractive or other visual care. (2) It was further proposed that a uniform dispensing fee of $5.00 be charged and collected for each pair of glasses fitted and adjusted, irrespective of whether or not a new frame was supplied. This $5.00 fee covered all subsequent frame adjustments on that pair of glasses until it was necessary to again prescribe for the patient. (3) The patient is informed that all materials to be dispensed are available to him at the exact prescription laboratory cost of these materials to the optometrist. These materials, being dispensed as they are at prescription laboratory cost, must of necessity be paid for at the time the materials are delivered to the patient. In other words, materials must be on a cash basis. The amount being the total prescription laboratory cost of these materials along with the cost of a case, postage and insurance and sales tax, if any, added.

In Part I the writer also reviewed the need for changing the fee structure at this time, and pointed out the advantages to the profession, the individual optometrist, the patient and the laboratory in adopting the new proposed fee structure and in dropping the now outmoded one total overall fee for professional services, dispensing and materials. The disadvantages of the current one total overall fee now in use were reviewed.

In proposing a change of this kind, many questions naturally arise in the minds of readers, and in this portion of this report, the

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‡Part III of this report will appear in the September issue. Part I appeared in the July issue.

more frequently asked questions are presented with the answers as developed from experience with those who have used this new fee structure for some time.

QUESTIONS AND ANSWERS

Q. You use the term "examination and refraction." Just what is meant by this?

A. The examination covers the case history: external ocular inspection of the eyes and lids: the versions: the ophthalmoscopic examination: the pupillary reflexes, and the tension as taken by palpation. The refraction includes the skills tests: the ophthalmometric findings: and all of the tests generally referred to as analytical with their findings, followed naturally by the final diagnosis and prognosis including a prescription for glasses, if one is called for.

Q. Why do you say "the one total overall fee system is outmoded?"

A. When one total fee is presented for professional services including dispensing and materials, we have learned by experience that the patient leaves the optometrist's office convinced that his glasses cost the amount of the total fee. For years, we have been trying to change this with little or no success. The solution is to make the materials available at the prescription laboratory cost and collect separately for these. This identifies the cost of materials in a most forceful manner, and the professional service fees are not confused with the charge for materials. The one total overall fee is outmoded because the public is becoming more and more aware of the actual cost of ophthalmic materials, and is unwilling to pay what seems to them to be a high mark-up on these.

Q. Can patients understand the new proposed fee system?

A. In offices where this plan has been carried out for a considerable period of time, the patients in general understand it, as it is simple and logical. Patient reaction is good.

Q. Must the minimum fee for examination and refraction be $10.00?

A. The minimum fee should be set by each optometrist. This is an individual matter. The writer proposes a minimum of $10.00 as he believes optometrists are entitled to at least this minimum fee for the excellent and important work they do. Many optometrists will want and get a larger minimum.

Q. What about progress report office calls?

A. The writer believes it has been the custom among most of those who require progress reports, to make these reviews without additional cost to the patient. Here the assumption has been that the original examination and refraction fee covered the subsequent progress

report office calls. The writer has recommended no change in this procedure at the present time. It is possible that in the future, these too may warrant a modest office call fee.

Q. Speaking of actual office procedure, what are the most significant changes to be made in our practice routine in adopting your proposal?

A. First, the abandonment of the one total overall fee and the substitution of a separate and individual statement for professional service and a second statement for materials only. Next, all materials are on a "cash" basis, to the patient, at the prescription laboratory cost to the optometrist.

Q. My fees are now higher than you suggest. What do I do?

A. The proposal carries only suggested fees. Each optometrist must establish his own minimum. The writer suggests, however, that no minimum be less than $10.00. In some practices the minimum would be $15.00. In others, $20.00 and in a few optometric practices the minimum would be $25.00. This is an individual matter which each optometrist must decide for himself.

Q. If this plan is adopted, what is to prevent the laboratories that serve us from getting together and materially raising the cost of materials to the optometrist?

A. Normal competition among them will keep costs at a proper level. In addition, right now the U. S. Department of Justice is showing a very significant interest in the cost of these materials—particularly the cost the patient must pay for them. The writer does not anticipate a significant raise in the charges to the optometrist for materials.

Q. Dispensing is time consuming. Why should the fee for this be only $5.00?

A. It is true that considerable time can, and frequently must, be spent in dispensing, particularly in some cases. It must be remembered, however, that it takes much less time to learn to fit and adjust frames than it does to learn to examine and refract eyes. The fees, therefore, are more or less in proportion, taking into consideration the actual time consumed in doing this work by the optometrist.

Q. You use the term "prescription laboratory cost." Is this the same as the "wholesale" price of ophthalmic materials?

A. No, it is not. The prescription laboratory cost is the price charged the optometrist by the laboratory for grinding and inserting one pair of prescription ophthalmic lenses either in the patient's frame, or in a new frame selected by the laboratory to satisfy the requirements of a single order. The wholesale price of ophthalmic materials applies to these materials only when purchased in like units, either lenses or

frames, in quantity. The laboratory prescription cost is for individual fabrication of a separate pair of glasses, and is always somewhat more costly than the same material when ordered in quantities of 10 or more.

Q. Why should the sample frames shown the patient be price marked?

A. It is much more convenient to have them clearly price marked with the exact cost of one such frame at the prescription laboratory cost to the optometrist. It eliminates mistakes and assures the patient that the price he is paying for the frame is the price charged all patients for this frame.

Q. Should the patient make out his bank check for materials directly to the laboratory?

A. This, of course, is up to the optometrist, but why not? If it is done, the check is then merely held until the end of the month and is then returned to the laboratory after the monthly statement for materials has been verified by the usual routine methods.*

Q. Should the optometrist announce, in a letter addressed to his patients, his adoption of this new fee structure with its resultant reduction in the cost of actual materials?

A. Some have done this. Others just made the change and let the story get around by word of mouth. Either plan is effective and both have been tried with success. If a letter is used, then two words of caution, first, do not emphasize the fact that materials are considerably reduced in price. This will make patients believe they were too high priced before, and they might resent this. Second, if a letter is used, one should send the letter only to one's own patients, and not send this letter abroad to a general list.

Q. Will patients pay cash for materials as suggested in this proposal?

A. They will. They easily see the fairness and justness of the request, and, as they understand all must do so, they will pay without protest.

Q. Why do you call it "dispensing?" Why not use the terms "fitting, servicing and adjusting," etc?

A. Dispensing is a universal term all understand, and it covers the entire activity. Why complicate things by using two or three terms when one will suffice?

Q. Should the fee for "examination and refraction" and the fee for "dispensing" be lumped together on the statement presented to the patient for these professional services?

*Optometrists should discuss this with their laboratory people before putting this suggestion into effect.

A. Both should appear on the same statement as separate entities, and then totaled.

Q. Will more patients order extra pairs of glasses under this new proposal than before?

A. The answer is that about 20 per cent more patients will do so.

Q. When should I start, and what must I do to get started?

A. You may start as soon as you have the prescription laboratory cost of materials at hand so that you can compute the cost of these for the patient.

Q. Is the proposed plan suggested by you, sponsored by the American Academy of Optometry?

A. No, it is not. The Academy sponsors nothing of this sort. A member of the Editorial Council of the Academy authorized the publishing of this report, but this does not constitute Academy endorsement or sponsorship.

Q. Have many of the optometrists who tried out this proposal on an experimental basis gone back to the old one total overall fee system?

A. None that I know of.

Q. Was this proposal made by you, in the effort to embarrass those optometrists still in commercial practices?

A. By no means. The proposal was made to help the great group of optometrists who practice professionally.

Q. What fee is charged when no glasses are required?

A. The minimum fee for examination and refraction.

Q. What fee is charged when a suspected pathology is found and the case is referred to an ophthalmologist for further attention?

A. At least the minimum fee for examination and refraction. All of the work should be done before referral.

Q. Is this new proposed fee system taught in any of our optometric schools or colleges?

A. Several schools have recently taught their undergraduate senior students, fee structure plans, quite similar to the proposed program of fees as outlined in this report. More are planning to do so.

Q. Will the adoption of this new schedule of fees increase the income and financial well-being of optometrists?

A. It will increase it substantially for several reasons, these being (1) better fees in the majority of cases, (2) no capital tied up in unpaid bills accounts for materials and (3) no capital tied up in slow moving inventories of materials, many of which now rapidly become obsolete.

Q. Is the same general plan followed in fitting contact lenses?

A. Yes. Here the suggested minimum fee becomes $100.00 and

the materials, in this case contact lenses, are supplied the patients at the prescription laboratory cost.

Q. Is the same general plan followed in fitting subnormal visual aids?

A. Here the examination and refraction fee must be specifically set depending upon a number of factors, these being the skill and knowledge required in doing the work, plus the time involved in training the patient to use the device. The device is supplied the patient at the prescription laboratory cost.

Q. Dentists include their material charges and professional fees in one professional statement. Why should optometrists do differently?

A. The situations are not the same and while the comparison is frequently made by optometrists in supporting their use of the one overall fee system it is not a legitimate comparison. Dental materials cannot be "worn" as are glasses, nor can they be individually purchased by the public as a commodity, as glasses can be. In addition, dentistry has eliminated to a large extent the commercial dentist, and dentistry does not have a retail dental laboratory to contend with as optometry does in the retail commercial optician where glasses can be readily duplicated.

The public is becoming more and more aware of the general underlying costs of ophthalmic materials thus making it more difficult for optometrists to conceal part of their fees in the necessary high markup on these materials when this is done. This is not true in dentistry, where the markup is even higher, but where only one professional group has control of the entire distribution of materials and is therefore in a better position to keep the actual costs of these from becoming public knowledge.

Furthermore, combining charges for materials with professional fees has not always helped dentistry, and some think it has retarded it. Today many progressive dentists are beginning to realize this and are now making a flat professional fee charge of $10 to $12 per hour for their work, plus the cost of actual materials used.

Q. Should optometrists carry stocks of materials?

A. The trend is away from his doing this. Under the new proposal there is no financial advantage worth mentioning in doing so.

Q. Will the proposed plan of yours be approved by the retail dispensing optician?

A. His approval has not been asked. He will probably object to it, particularly in view of his now substantial mark-up of materials to the patients he serves.

Q. Are any ophthalmologists following your new proposal?

A. Yes. In several places to my knowledge, and I am told with considerable success.

Q. Does the plan you propose violate the fair trade practice law?

A. It does not violate any law in my judgment. Optometrists are not in "trade." They are professional people dispensing materials they largely prescribe. Very few if any minimum prices have been fixed on brand name frames or lenses. An executive of a large laboratory claims he knows of none. Fair trade measures permit the fixing of "retail" prices on trade-marked and brand named merchandise. Ophthalmic lenses and frames do not and should not fall into this catagory. Should an ophthalmic manufacturer elect to force a high dispensing fee for his product by this means, optometrists would simply disregard his product and prescribe a similar item made by some other manufacturer which has not been registered as a fair trade item.

Q. What is the reaction of the laboratory people to this proposal?

A. It should be most favorable, and to date it has been. It eliminates many of their present problems and creates no new ones.

Q. In orthoptic cases where treatment is necessary what minimum office call fees do you suggest?

A. Treatment fees are not part of this report but a minimum office call fee of $2.00 is certainly justified. Many optometrists have a minimum orthoptic treatment fee of $3.00 for each office visit. Some charge more.

Q. Will this plan assist optometry in becoming more ethical?

A. It will and it has. It puts the optometrist on an entirely fee basis. The fees are not hidden. The plan produces professional respect and encourages ethical practices.

SUMMARY

The new proposed simplified fee system for optometrists is reviewed. In addition, a number of leading questions which have been asked about the plan have been answered.

CONCLUSION

The new proposed fee structure, already in use in a number of offices, is being given wide study by many optometrists. In Part III of this report, to appear in the September issue, various comments regarding the plan will be presented. These comments are from optometrists of considerable experience in optometric practice, and will give the reader a cross section of views on these proposals, and their effect upon the patient-optometric relationship, and the effect of these proposals on the profession itself.

A STUDY OF THE RELATIONSHIP BETWEEN LATERAL PHORIA AND AGE*

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INTRODUCTION

Previous investigators have studied the relationship between phoria and age using clinical methods of measurement. Hirsch, Alpern, and Shultz[1] (p. 535) state, "The idea that exophoria tends to increase with age has been current for a long time and has stood the test of agreement with common experience even if it has escaped statistical investigation."

In their study of 1,192 cases taken from clinic files at The Ohio State University, School of Optometry, they found that the coefficient of correlation between phoria and age was —.075 for measurements at 40 cm., and .0796 for measurements at 6 M. The probabilities that these correlations could be due to errors in random sampling from a population in which no correlation existed are .01 and .006 respectively.

Weymouth, Brust, and Gober[3] in a study of 153 cases found a coefficient of correlation of —.021 between near phoria measurements and age. They state that this is too small to be of any practical value.

Scobee and Green[2] in a study of 184 males found the coefficient of correlation between age and phoria measurements to be .17 at 6 M and —.12 at 13 inches. A similar study of 217 females revealed correlations of —.20 at 6 M and —.19 at 13 inches.

PROCEDURE

The Occupational Research Center at Purdue University is engaged in continuing analysis of vision test scores from industrial concerns subscribing to the Bausch and Lomb Industrial Vision Service. Over a number of years more than 500,000 test scores have been accumulated. These test scores represent employees in all types of American industry and from all parts of the country. By selecting at random from these files it is felt that a random sample of the American industrial population can be obtained.

For the purpose of the present study, approximately 8,000 phoria

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test scores were selected at random from the Occupational Research Center files. These cases represent 37 industrial concerns from all parts of the United States. The cases so chosen included 6,000 males and 2,000 females. (In large testing operations such as this it is inevitable that examiners will forget occasionally either to administer or to record one or more tests in the battery. Therefore, the number of available scores is slightly less in each test distribution than the total number of scores.)

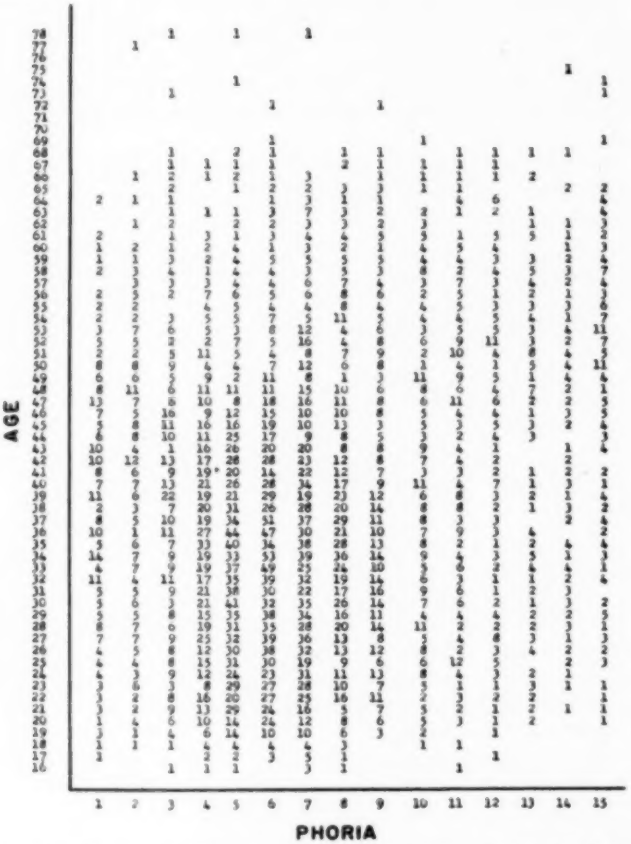

Fig. 1. Scatter Diagram of Near Lateral Phoria Scores Versus Age for Male Industrial Employees.

Included with the ortho-rater test scores were data on age for each worker. The age data were obtained by asking the worker his age at the time of testing and therefore represent, in most cases, age at last birthday. The accuracy of the age figures is similar to that in other situations where dependence is placed on the subject's report. The data were recorded in one year intervals.

Pearson product-moment coefficients of correlation were computed between age and the ortho-rater lateral phoria scores at both the near and far distance. These coefficients were obtained independently for males and for females.

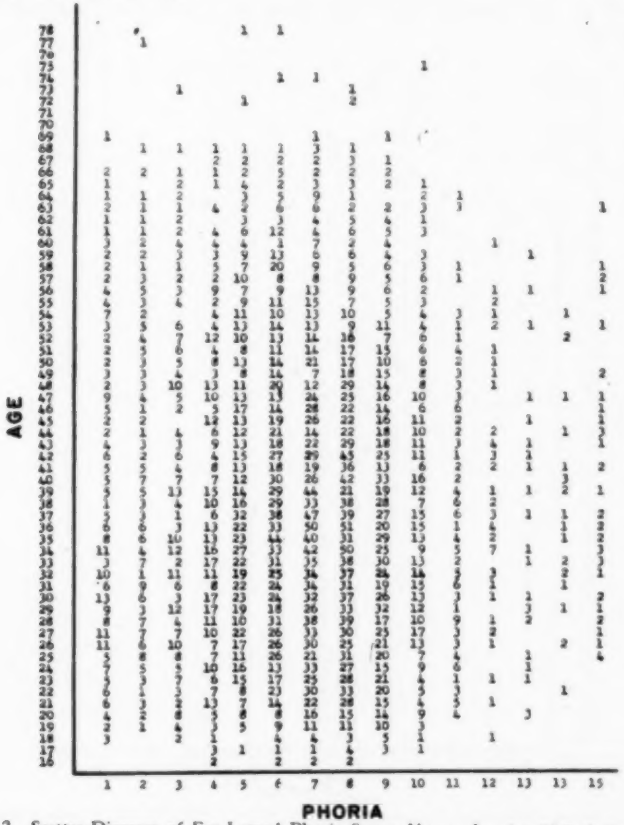

Fig. 2. Scatter Diagram of Far Lateral Phoria Scores Versus Age for Male Industrial Employees.

RESULTS

Table I shows the number of cases used in each correlation study, the mean age, and age range. Also shown are Pearson product-moment coefficients of correlation between ortho-rater lateral phoria measurements and age as revealed by these data. The scatter diagrams upon which these coefficients are based are shown in Figures 1, 2, 3 and 4.

It will be seen that the age range for males is from 16 to 78 years whereas that for females is from 16 to 72 years. For far lateral phoria the correlation coefficients are .039 for males and .016 for females. The former of these coefficients, although small, is statistically significant beyond the .01 per cent level. The latter coefficient is not statistically significant.

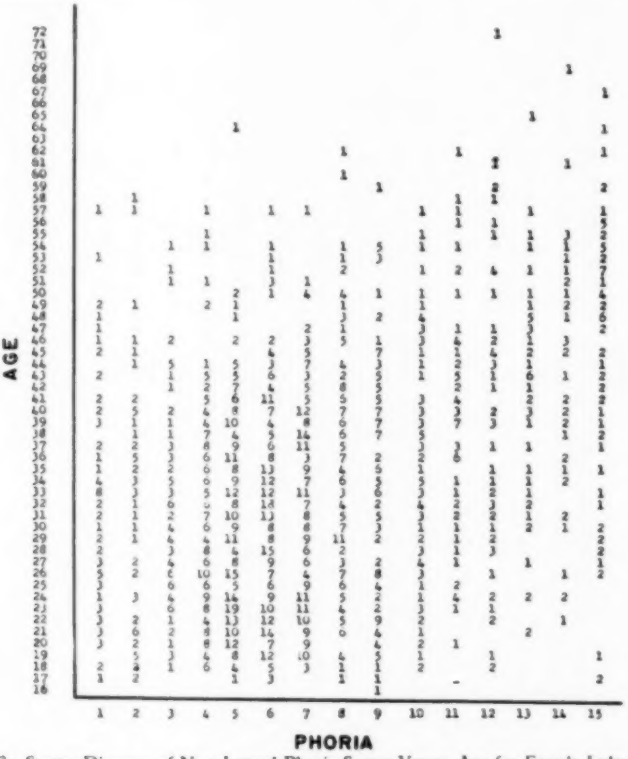

Fig. 3. Scatter Diagram of Near Lateral Phoria Scores Versus Age for Female Industrial Employees.

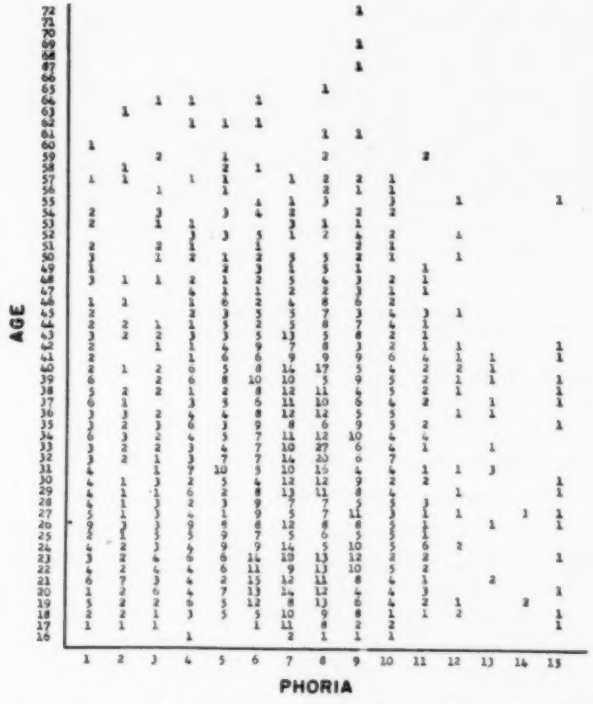

Fig. 4. Scatter Diagram of Far Lateral Phoria Scores Versus Age for Female Industrial Employees.

TABLE I

Relationship Between Phoria and Age

Test Classification	N	Age Range	Mean	(r) Phoria and Age
Lateral Phoria (far)				
Males	6048	16 - 78	37.5	+.039 ± .01
Females	1931	16 - 72	32.8	+.016 ± .021
Lateral Phoria (near)				
Males	5954	16 - 78	37.3	—.178 ± .01
Females	1774	16 - 72	33.4	—.348 ± .015

A positive coefficient of correlation indicates a trend from exophoria toward esophoria with age increments. A negative coefficient of correlation indic tes a trend from esophoria toward exophoria with age increments. The signs of the ortho-rater coefficients have been changed to agree with those of other workers.

At the near distance the correlation coefficients are —.178 for males and —.348 for females. Both of these coefficients are significant beyond the .01 per cent level.

From these data it would appear that there is a slight tendency toward esophoria with increasing age in male industrial personnel. This tendency is not of sufficient magnitude to permit prediction. At the near distance for both males and females there is some tendency toward exophoria with increasing age. The highest single relationship (.348) is found for females at this distance. Even this coefficient, however, is too low for individual prediction.

TABLE II

Lateral Phoria and Age Relationships

Investigator	N	Far	Near
Weymouth, Brust and Gober	153		—.021
Scobee and Green (males)	184	+.17	—.21
(females)	217	—.20	—.19
Hirsch, Alpern, and Shultz	1192	+.08	—.08
Kephart and Oliver (males)	6048	+.039	
	5954		—.178
(females)	1931	+.016	
	1774		—.348

Table II shows the relation of lateral phoria and age as obtained by previous investigators together with that of the present investigation. The coefficients of correlation obtained with far phoria measurements all indicate a very slight trend from exophoria toward esophoria with increasing age except that obtained for females by Scobee and Green (2) who found a similar but inverse relationship.

The coefficients of correlation obtained for near phoria measurements are indicative of a slight trend from esophoria toward exophoria with increasing age. In view of the fact that the coefficient found in the present study (—.348) was significantly greater than that found by Scobee and Green (—.19) and since the present sample differed from that of Scobee and Green in that it was based on industrial personnel, a partial coefficient of correlation was computed between near lateral phoria scores and age with length of experience on the job held constant. This procedure did not serve to reduce the original coefficient between phoria and age. It would therefore appear that the somewhat higher coefficient found in the present study cannot be accounted for by experience on an industrial job.

SUMMARY

Pearson product-moment coefficients of correlation were computed

between age and near and far lateral phoria scores of approximately 6,000 male and 2,000 female industrial employees. The coefficients of correlation between age and phoria scores at the far distance indicated a slight tendency toward esophoria with increasing age for both males and females: those at the near distance indicated a slight tendency toward exophoria with increasing age for both groups. All coefficients were statistically significant except that for females at the far distance. None of the coefficients was sufficiently high to permit prediction.

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[1]Hirsch, M. J., Alpern, M., & Shultz, H. L. The Variation of Phoria With Age. Amer. J. Optom., 1948, 25, 535-541.
[2]Scobee, P. G., & Green, E. L. Relationship Between Lateral Heterophoria Prism Vergence and the Near Point Convergence. Amer. J. Ophthal., 1948, 31, 427-441.
[3]Weymouth, F. W., Brust, P. R., & Gober, F. H. Ocular Muscle Balance at the Reading Distance and Certain Related Factors. Amer. J. Physiol. Optics, 1925, 6, 184-205.

ANNOUNCEMENTS

RUTGERS INDUSTRIAL VISION CONFERENCE

Rutgers University will hold its second annual occupational vision conference in November, with the New Jersey Optometric Association being one of the seven sponsoring groups. The Illuminating Engineering Society, National Society for the Prevention of Blindness, New Jersey State Department of Health, New Jersey State Department of Labor and Industry, the New Jersey Safety Council, and the New Jersey Society of Professional Engineers will cooperate in putting on the conference.

Testing procedures, visual conservation practices, eye safety methods, and ways of improving environmental factors for visual efficiency will be subjects for discussion. The economic aspects of an occupational vision program will also be discussed. Dr. Charles F. McCuen, vice president and general manager of research laboratories of General Motors, will be the featured banquet speaker.

COMPENDIUM ON EYE PROTECTIVE DEVICES*

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PART II§

SPECIFICATIONS AND STANDARDS

The U. S. Bureau of Standards make the following recommendations regarding visual protection devices:

Frames. Frames shall be made of a material that will withstand sterilization and will not readily corrode and will not discolor the skin. Frames shall have a smooth finish.

Lens Containers. Containers shall be suitable for holding lenses of the following dimensions:

> All lenses shall have dimensions not less than 1.5 inches. (38 mm.) in the vertical direction and 1.75 inches. (44.5 mm.) in one horizontal direction. It is recommended that circular lenses not involving optical correction be of uniform diameter of 1.97 inches. (50 mm.).

Temples. Temples shall be made of a material which can be sterilized without deterioration and will not readily corrode and will not discolor the skin. Ear hooks for temples shall be flexible, properly formed to fit the ear, and so finished or covered as not to cut or irritate the skin. No quick-burning materials shall be used. If a covering be used, it shall extend for half the length of the temple and be of a material which will not be readily deteriorated in service. The screw or rivet which fastens the temple to the frame shall not also be used to hold the lens in the container.

The construction of the goggles shall be such as to permit the folding of the temples so that they may be stored in a case or container.

Short temples may be substituted for full-length temples. They shall be made of a material that will not readily corrode and will not discolor the skin. They shall be attached to the frame in the same manner as above and be interchangeable with the full temples. A head band shall

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*Read before the New Jersey Chapter, American Academy of Optometry, Trenton, New Jersey, as one of a series of lectures on occupational optometry. For publication in the August, 1952, issue of the AMERICAN JOURNAL OF OPTOMETRY AND ARCHIVES OF AMERICAN ACADEMY OF OPTOMETRY.
†Optometrist, Fellow, American Academy of Optometry.
‡Optometrist, Fellow, American Academy of Optometry.
§Part I appeared in the July, 1952, issue

be fastened to the outer ends of the short temples and shall be adjustable as to length and easily replaceable.

Headband or Headgear. In lieu of full temples or short temples, a headband or headgear of any suitable material and design may be supplied that will properly retain the goggles in position and afford comfort and protection to the wearer. Such headgear shall be adjustable as to size or shall be supplied in properly assorted sizes.

Connection between lens containers, nosepieces, bridges, or connecting links between lens containers shall have the portions that come in contact with the skin of a material that will not readily corrode and will not discolor the skin. The construction shall be substantial and the nosepiece, bridge, or connecting link shall be securely fastened to the lens containers. If the weight of the goggle is borne by the bridge or nosepiece resting on the crest or sides of the nose of the wearer, these portions of the goggles shall have broad comfortable surfaces. The nosepiece, bridge, or connecting link shall be so constructed as to be readily adjustable, or the goggle shall be furnished in assorted sizes.

Side Shields. If goggles are provided with side shields, such shields shall be made of metal, leather, or other material of suitable durability. No quick-burning material shall be used. The material shall be sufficiently pliable to permit adjusting the shield to the contour of the face. The edges coming in contact with the face shall be furnished in a manner to prevent irritating or cutting the skin. If the side shields are of metal, they shall be of a wire mesh or of perforated sheet having openings not larger than 0.0394 in. (1 mm.). Adequate ventilation shall be provided.

Eyecups. Eyecups shall be made of rigid, noninflammable material that will not readily corrode and will not discolor the skin and can be sterilized without deterioration. They shall be shaped to conform to the configuration of the face and shall have edges which will not cut the face. Proper ventilation shall be provided and the goggles shall be fitted with a headband or headgear of cloth, leather, or other suitable material, which will retain them in their proper position with reasonable comfort.

Lens Containers. Containers shall be suitable for holding lenses of dimensions specified below:

> All lenses shall have dimensions not less than 1.5 inches. (38 mm.) in the vertical direction and 1.75 inches. (44.5 mm.) in one horizontal direction. It is recommended that circular lenses not involving optical correction be of uniform diameter of 1.97 inches. (50 mm.).

They shall be designed to permit easy replacement of lenses.

Cup Type Goggles

A comparison of the cup type goggles of three leading manufacturers is presented in Table I.

TABLE I

	A*	B	C
Eyecup	Individual anatomically designed cups with or without rubber cushions, non-conductive.	Individual anatomically designed cups.	Individual anatomically designed cups
Bridge	Insulated ball chain or leather.	Insulated ball chain.	Insulated ball chain.
Headband	One piece all rubber, adjustable.	Elastic or rubber.	Elastic.
Lenses	Hardened lenses —1.25 or —6.00 base curve white or calobar (B. C. & D).	Normally supplied with hardened —1.25 base curve lenses, available in —6.00 curve.	Hardened lenses, flat.
Other Features	Ventilated, black in color, threaded lens ring.	Ventilated, black, neoprene rings.	Ventilated, metallic, shock absorbing, space ring.
Sizes	50 mm. round. 48.8 mm. round.	50 mm. round.	50 mm. round.
Types	301 Duralite. 120 Drednaut. 351 Air Conditioned. 361 Chemical. 321 Chipper's. 402 Duraweld Dust.	S-51 Chip-Ban. S-59 Acid-Ban. S-54 Arc-Ban (Welding) T-51 Dust-Band. S-64 Acetylene. S-71 Coverall. S-61 Chip. S-71P Coverall. S-64P Arc-Ban (Welding).	

*(A) American Optical Company. (B) Bausch & Lomb Optical Company. (C) Wilson Products, Inc.

Lens Size

There are distinct variations in the size of lenses as supplied by various manufacturers. In Table II is presented a comparison of a few types of goggles as made by three leading companies.

TABLE II

Type of Gogele	A	B	C
Cup type	50 mm. round.	50 mm. round.	50 mm. round. 47.5 mm. round.
Spectacle type	42 mm. round. 44 mm. round. 47 mm. round. 50 mm. round.	42 mm. round. 44 mm. round. 47 mm. round. 50 mm. round.	47.6 x 55.8 mm. drop. 42.1 x 51 mm. drop. 50 mm. round. 45.8 mm. round. 52 mm. round.

There are several types of goggles for specific occupations individually designed by the various manufacturers which vary in size and shape one from the other which cannot be included here. To those interested, obtain the various catalogues for more detailed study.

Color of Lenses

In protective glasses most lenses are supplied in white ophthalmic glass. The exceptions are for those occupations in which some type of absorption glass is required. The following is a list of various trade or brand names used by the manufacturers of these products.

TABLE III

A	B	C
Calobar:	Ray-Ban:	Willsonite:
Medium.	One.	A.
Dark.	Two.	B.
Extra Dark.	Three.	C.
Noviweld (Green).	Arc-Ban (Green).	Wilson-Weld (Green).
Filterweld.	Melter's.	Cobalt Blue.
Amber.	"Ohio Blue."	(3, 4, 5, 6, 7, 8, 10, 12, & 14).
Cobalt Blue (C1, C2, C3, C4, C5, C6, C7, and C8).	Bessemer Lenses.	
Didymium.		
Noviweld-Didymium.		

Absorption glass used in protective glasses has various properties and these are outlined in the two tables which follow. The data in Table IV are that prepared by the Bausch & Lomb Optical Company, and Table V by the American Optical Company. While the tables differ somewhat the major characteristics and uses of each type of protective absorption glass is presented.

TABLE IV.

TRANSMISSION TABLE FOR BAUSCH & LOMB GLARE PROTECTION AND WELDING LENSES

GLASS	SHADE NO.	STD. VIS. TRANS.	ULTRA-VIOLET TRANS.	INFRA-RED TRANS.	RECOMMENDED USES
Ray-Ban 1	1.7	50%	less than 0.5%	12.5%	Glare of reflected sunlight from snow, water, sand, etc.; stray light from cutting and welding, metal pouring, and work around furnaces and foundries.
Ray-Ban 2	2.0	37%	less than 0.5%	4.1%	
Ray-Ban 3	2.5	24%	less than 0.5%	2.3%	
Arc-Ban	3.0	13.9%	less than 0.5%	0.9%	
Arc-Ban	4	5.18%	less than 0.1%	less than 0.01%	Light acetylene cutting and welding; light electric spot welding.
Arc-Ban	5	1.93%	None	less than 0.01%	
Arc-Ban	6	0.72%	None	less than 0.01%	Acetylene cutting and medium welding; arc welding up to 30 amperes.
Arc-Ban	7	0.27%	None	less than 0.01%	
Arc-Ban	8	0.100%	None	less than 0.01%	Heavy acetylene welding; arc cutting and welding between 30 and 75 amperes.
Arc-Ban	9	0.037%	None	less than 0.01%	
Arc-Ban	10	0.0139%	None	less than 0.01%	Arc cutting and welding between 75 and 200 amperes.
Arc-Ban	11	0.0052%	None	less than 0.01%	
Arc-Ban	12	0.0019%	None	less than 0.01%	Arc cutting and welding between 200 and 400 amperes.
Arc-Ban	13	0.00072%	None	less than 0.01%	
Arc-Ban	14	0.00027%	None	less than 0.01%	Arc cutting and welding above 400 amperes.

TABLE V.
TRANSMISSION TABLE FOR AMERICAN OPTICAL COMPANY GLARE PROTECTION AND WELDING LENSES

The Job	*The Glass	Density	Visible Light Transmission	Ultra-Violet Absorption	Infra-R d Absorption
	NOVIWELD				
Carbon arc welding and cutting. Electric furnace operation.	14	5.57	.0003%	100%	99.99%
Metallic electric arc welding 250 amperes or more.	12	4.71	.0019%	100%	99.99%
Metallic electric arc welding 75 to 250 amperes.	10	3.86	.014%	100%	99.99%
Heavy acetylene cutting and welding.	8	3.00	.10%	100%	99.9%
Acetylene welding. Set-up work on electric welding. Fire box observations.	6	2.14	.72%	100%	99.9%
Acetylene burning, cutting and brazing.	5	1.71	1.9%	100%	99.8%
	4	1.29	5.2%	100%	99.5%
Light brazing.	3	0.86	14%	99%	98%
	CALOBAR				
Bull ladlemen, spot, flash and seam welding.	Extra Dark	0.70	20%	100%	95%
	Dark	0.46	35%	100%	92%
Employees in area of electric welding, stray or reflected light, low temperature fire box observations, rivet heaters, ladlemen, hand pourers.	Medium	0.28	53%	100%	80%

*These numbers are from the Bureau of Standards density formula.

Replacement of Lenses (Plano)

Some employers prefer to use goggles of such a design that the lenses are permanently and securely held in the frame and are not replaceable except by the employment of special means. Broken goggles are allowed to accumulate, the ones broken being replaced by new goggles, until a large order can be sent to the manufacturer for replacement of lenses.

On the other hand, other employers prefer to replace their own lenses, in which case it is desirable that this may be easily done in order to discourage the retention in service of broken goggles. Goggles whose lenses may be replaced merely by unscrewing a portion of the lens container, by the proper manipulation of specially constructed parts of the frame, or by the use of a tool generally available, such as a screw driver, are suitable.

It is desirable that lenses and lens containers of goggles designed for a given operation be made uniform as to dimensions so that they may be readily interchanged or replaced. Some manufacturers prefer to use a specially designed size or shape for processes involving hazards of one degree and different size or shape for hazards of another degree.

Thickness of Lenses

Lenses shall have a thickness of not less than 0.079 inches or 2.8

mm. (Plano safety, 3.00 mm. Corrective protective.)

If a single window is used in place of separate lenses, it shall have dimensions of not less than 4.25 inches or 10.8 cm. in one direction this being the horizontal, and not less than 2 inches or 5.1 cm. in the vertical direction.

Transmission Properties

White lenses shall transmit not less than 70 per cent of the visible light from a 200-w, 115-v, gas-filled, clear glass, tungsten-filament, electric incandescent lamp operating at its commercial rating.

Light Absorption Properties

A high percentage transmission of light is important. Almost any lens made of so-called "colorless" or white glass will transmit more than 80 per cent of the incident light. Laminated lenses consisting of two glass elements held together by a layer of other material may not have as high transmission, so the limit has been placed at 70 per cent. The latter may become cloudy or may darken when subjected to heat, depending on the material which is used between the glasses.

Curves of Lenses

Lenses for protective goggles are ground in three curves. These are: (1) Flat. (2) —1.25 D. base curve. (3) —6.00 D. base curve.

Identification

In industrial eye care programs it is essential that each protection device shall be marked distinctly to facilitate identification. The identification marks of the three leading manufacturers are: "AO" for American Optical Company; a circle enclosing an inverted triangle for Bausch & Lomb Optical Company and a "W" for the Wilson Products, Inc.

Heat Treated Lenses

The National Bureau of Standards code No. H-24, establishes limits and testing methods for lenses to be used in safety goggles. The type of lens described is of a single solid piece of glass toughened by heat treatment. Although variously described as "case-hardened," "hardened," "tempered," etc., lenses of this type are in reality lenses in which the distribution of strain has been so adjusted by heat treatment that the outside surface of the glass is under compression. Glass under compression resists impact many times more than glass fully annealed.

Mechanical Tests for Lenses

(A) A spherical steel ball weighing approximately 0.565 ounces shall be dropped from a height of 39.37 inches (1 M.) on the center of the horizontal outer surface of the lens. The lens shall be placed flat

on the end of a wooden tube having a rim to fit the lens. The tube shall have an internal diameter of 1.77 inches (45 mm.), shall be not more than 2 inches (51 mm.) long and shall be supported on a steel block. A washer of rubber packing, not more than $\frac{1}{8}$ inch (3 mm.) thick, and of some internal diameter as the tube, shall be placed between lens and tube. If one out of six lenses is fractured, the lot shall be rejected.

(B) A spherical steel ball weighing approximately 0.565 ounces shall be dropped from a height of 39.37 inches (1 M.) on the center of the horizontal outer surface of the lens. The lens shall be supported as in the above paragraph. If one out of six lenses tested is fractured in such a way that a fragment of glass weighing more than 0.39 grain (25 mg.) leaves the bottom surface, four more lenses shall be tested, and if one of these lenses fractures in the above-described manner, the lot shall be rejected.

Tests for Frames

(A) *Flat Transverse Test* Each frame tested shall have the right lens container laid flat, with the outer surface of the lens downward, on a firm, level support so that the left lens and one-half of the bridge projects beyond the edge of the support and shall be held in this position. A spring balance shall be attached to the outermost portion of the frame of the left lens, and a downward force of 8 oz. (226 g) shall be applied while the right lens frame is rigidly held. After removal of the load, no permanent deformation shall be apparent in the frame.

(B) *Edge Transverse Test* Each frame tested shall have the right lens container held vertically in one hand and the lower edge of the left lens container, as worn, pressed against one of the platforms of an equal-arm balance having a weight of 4 lbs. (1.82 kg) on the other platform. The pressure shall be increased until the weight is balanced, whereupon the frame is removed and examined. No permanent deformation shall be apparent in the frame.

(C) *Strength Test for Lens Containers* Lens containers shall be substantial in construction and each container tested shall withstand, without distortion, the drop test prescribed heretofore.

(D) *Test of Joints* If the lens containers are rigidly joined by a separate bridge or nose piece in any manner whatsoever, the joints shall be given the following tests to demonstrate their strength and durability. Goggles which have already passed the strength test of the above mentioned, may be used for this purpose. The lens containers with lenses in place shall be gripped one in each hand, the thumbs bearing on the outer surface near the bridge and the fingers on the inner surface of the lenses near the junction of the bridge and the lens container. The frames shall then be slowly bent, the direction of motion being in a plane perpendicular to the surface of the lenses, until the outer surfaces of the lenses face each other, the outer ends of the frames touching. The frames shall then be bent back to their original shape and a careful inspection made for failure in the joints. All frames tested shall pass this test without developing visible cracks.

TAKING MEASUREMENTS

It is important that corrective-protective safety goggles be accurately fitted from the standpoint of both safety and optical accuracy. Most industrial plants have standardized on certain types of goggles for specific hazards because of the individual hazards involved in certain operations,

i.e., the direction from which chips or other substances may fly, certain dust hazards and also, from the standpoint of providing certain workers with a minimum of obstruction to vision sideways or downward.

Sometimes it is necessary to prescribe different frames and lenses than those specified by the safety engineer due to technical problems involved, such as height of bifocal, power of lenses, etc., so that both the safety and optical properties of the lenses will be accurate. Where such problems arise, the matter should be discussed with the plant safety engineer or other responsible persons.

Employees may often request types or styles of goggles or safety spectacle frames which deviate from the established standard for their particular type of work. This should be discouraged, as the introduction of a different style of goggle into a particular department of the plant, may cause dissatisfaction among other employees. Furthermore, safety goggle frames are purposely made rugged and, therefore, heavier than equivalent ophthalmic material, because of the abuse to which industrial goggles are subjected, and because of the necessity for firmly clamping the safety lenses in the frame, which adds to the strength of the lens, and tends to retain the particles in the frame should the glass be hit hard enough to break. Safety engineers insist that eye protection frames be selected with considerations of safety, style, etc., in the following order:

1. Safety is the first consideration.
2. Comfort in wearing the device.
3. Style and appearance.

Optometrists will often be called upon to assist in the training of technicians within the plant for fitting and servicing plano goggles, or taking measurements in connection with supplying corrective-protective goggles. Where information and training is requested, the following information will be of value. (It should be clearly understood by plant personnel that the various services in connection with supplying corrective-protective goggles, including fitting, re-evaluation, servicing, etc., are distinct responsibilities of the professional man responsible for the prescription.)

Prescription Lenses

The heat-treated or toughened lenses can be ground in prescription lenses either in single focus, bifocals or multifocal types. Such lenses are first ground and polished on thick blanks and then are subjected to the heat-treating process. The curves of such lenses can be ground the same as any ordinary ophthalmic lens, but are compensated for thickness.

The National Bureau of Standards Handbook, Section 14, Page 11 has this to say: "Employees whose vision requires the use of correctives lenses in spectacles, and who are required by rules to wear protective goggles, shall be provided with goggles of one of the following types: (1) Goggles whose protective lenses provide the proper optical correction and withstand the drop test. (2) Goggles which can be worn over corrective spectacles without disturbing the adjustment of the spectacles. (3) Goggles which incorporate corrective lenses mounted inside the frame holding the protective lenses."

Costs of Prescription Goggles

Since such lenses came long after the development and use of plano protective goggles, certain practices relative to the distribution and costs developed whereby the professional services were not considered and resulted in much misunderstanding and confusion on the part of industry, the manufacturer, and the profession.

The common practice in industry today is to obtain a copy of the prescription from the employee's own eye doctor or from the company eye doctor. This prescription is forwarded to the supply house with whom the particular company customarily deals. Most industries purchase the complete glasses and give them to the employee. Others charge the employee the actual cost. Still others pay part of the cost and bill the employee the rest. There apparently is no uniform method of procedure in this respect even in companies having several plants located in different locations.

Fitting and Adjusting

If goggles are to be worn, they must be fitted both comfortably and correctly. Ordinarily plano type goggles can be adequately distributed, adjusted and maintained by the safety department in any industry. Under no circumstances, however, should safety personnel, nurses, or others not thoroughly trained in eye work attempt to fit prescription goggles. The only logical person to supervise, or actually fit, such corrective-protective devices is the doctor who wrote the prescription for the goggles. The practice to be followed in all cases is to refer the employee back to the doctor who examined him. In this way, accuracy of the prescription can be expertly checked and the goggles correctly fitted for the individual's needs. This must be done before the employee is allowed to wear the goggles. It is also suggested, in such cases, that the employee be advised to check periodically with his doctor over a period of time. Certain lenses must be fitted in a definite manner and only the man familiar with the peculiar requirements of each case is the doctor who prescribed the goggles. It is appreciated on the other hand, that

sometimes the doctor is not as familiar with the requirements of the job as he might be. Frank discussion between the safety director and the doctor will result in closer cooperation and understanding between the two.

In fitting and adjusting goggles of the plano type, the following are safe rules to follow:

1. Supply the largest eye size possible to conform with the size and width of the head. The larger the lens, the more protection is offered.
2. Supply the narrowest bridge for the nose commensurate with comfort for the wearer. The less opening left between the lenses, the better the safety value.
3. Incline the frame inward as much as possible to conform with the sweep of the eye downward. Thick lenses will appear to distort objects if looked through at too great an angle.
4. Adjust temples so that they do not extend too far above or below the lobe of the ear. Temples should fit snugly and as closely to the ear and head as possible. Too short or too long a temple length will cause pain, discomfort, and slipping of the goggles.
5. Angle nose pads so that they rest snugly, but not too tightly, along the side of the nose and as much as possible parallel to the plane of the nose. This insures comfort and allows the frame to remain in the proper position.
6. Where side shields are indicated, form the shields to conform with the contour of the head at the temple area.

DISTRIBUTION AND FITTING

Since the inception of the safety movement, industry has always depended upon the manufacturer of ophthalmic materials to supply its eye protection needs. As the problem was one which primarily concerned safety engineers and optical manufacturers, the development, marketing and distribution of such material naturally flowed between these two groups. Plano goggles and other eye protective devices were purchased directly from the manufacturer and the responsibility for their distribution and maintenance placed in the hands of the safety department.

Through the years, various methods of distribution and maintenance have evolved, some adequate, others not. In some plants, goggles are distributed directly to the employee through the tool crib, the safety department specifying the type needed for each operation and instructing the area tool crib attendant as to proper distribution. In others, plant personnel are trained in the techniques of fitting, adjusting and maintenance of such devices and are delegated to perform those services. In smaller plants, the safety supervisor, himself, often performs such services, or calls upon the consulting eye man to care for this phase of the work. In some instances, mobile goggle service units have been installed. These units contain washing and sterilizing facilities, extra goggles, repair parts and optical tools and are manned by plant personnel. In others, the distribution, fitting and servicing is carried on in a special department or safety store, manned by trained personnel who are either members of

the ophthalmic professions or who serve under the direction of an ophthalmologist or optometrist.

Comfort and accuracy can *not* be obtained when goggles or safety glasses are merely handed to an employee through the tool crib window or given to him by his foreman. Facial contours differ: pupillary distances vary with each individual as do nasal widths and position of ears in relation to the eye level. Every goggle requires individual attention and adjustment, and many eye protection programs fail when careful fitting of goggles is neglected. Thus it is understandable why the companies with the best safety records are found to be those who provided for properly fitted goggles and who maintain efficient systems for the continuous servicing, refitting and adjustment of safety glasses.

Plano (non-focused) type goggles can be adequately distributed, adjusted and maintained by trained safety personnel: however, the examination for, and prescribing of, prescription safety glasses presents an entirely different problem which the profession must perform and thereby assist industry in promoting eye safety.

Safety Education

Eye safety education may take any one of a variety of forms in principle, but should be such as to demonstrate to employees: (1) The eye hazards of various jobs: (2) The social and economic penalties involved in loss of vision: (3) Ways and means available from the National Safety Council, insurance companies, government agencies and safety equipment manufacturers. All these are helpful in creating and maintaining safety awareness on the part of employees and supervisors.

Such educational measures are both necessary and desirable: however, there is no substitute for a forthright approach to the wearing of eye protection as a "condition of employment" in dangerous occupations. A condition which, when properly presented, is often accepted as a matter of course, unremoved from other rules of conduct on the job. Many companies have brought about the acceptance of this concept through the adoption of the 100 per cent goggle program: by incorporating rules on eye protection in union agreements: or, by active ministration of rules on eye protection formulated through the cooperative efforts of safety committees and employee representatives.

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BRITISH OPTOMETRIC PROBLEMS SHOULD ALERT AMERICAN OPTOMETRISTS

We learn that many optometrists now practicing under the National Health Service in Great Britain are in acute financial distress. This is due, first, to the serious reduction in fees paid these optometrists by their government and, second, to a very marked reduction in the total number of ocular examinations and refractions performed each month by these British optometrists.

We are constantly told that the British public are most appreciative of socialized medicine. We are told they would protest emphatically if

the scheme were abandoned. Eye care is part of the scheme. If it is so popular with the public—and if it seemingly costs the public so little—why, then, is it so ignored? For some reason which is not too clear, comparatively few patients are being refracted today in England. This condition has been true for the past year. Optometrists in England are making fewer examinations and refractions today than were done in the same period before the scheme was put into effect, and during the period when the public paid the full and customary fees for professional services and materials.

Now, under the scheme, we see medical, dental and optometric associations in England spending most of their time fighting for the actual survival of their members. On every hand we read that the health worker has had his income reduced to such a point that professional men are, as a whole, grossly underpaid—so much so that many of them cannot meet today's living costs.

The plight of the optometrist is particularly bad. If it continues, there will be long term repercussions as few would care to enter a profession where the financial returns were as small as those found today in Great Britain. To attract students, optometry must offer something more than a bare existence, under a regimented health program.

This most serious condition has existed in England for more than a year. Despite frequent protests by the leaders of the profession, the government officials in charge of the National Health Service have ignored the problem. Under these circumstances optometrists of Great Britain are in a rather helpless fix. The National Health Service scheme eliminated practically all of their private practice, and now to exist at all, optometrists must refract under the scheme for whatever pittance the government Health Bureau cares to pay them.

Editor Black of the *A. O. P. Newsletter* (London), issue of June 26, 1952, has this to say:

"In December last, we commented on the urgent need for a revision of the fees received by optometrists in view of the great drop in the demand for ophthalmic attention. This low level of demand has continued and the position is now so serious that many optometrists are suffering severe hardship.

"Several months ago the Staff side of the Optical Whitley Council made claim for increases in the sight testing and dispensing fees and a certain amount of dissatisfaction has been voiced at the delay in securing a meeting with the Management (Government) side. This full meeting of the Whitley Council has now been fixed for June 30th, and it is hoped that the negotiations will be brought to a speedy and successful conclusion.

"In order to alleviate the current and widespread financial distress among optometrists the Association of Optical Practitioners has asked the Whitley Council to make an immediate interim increase in fees while the negotiations are taking their course. It is to be hoped that this demand will be pressed forcibly at the meeting on June 30th."

Optometrists in the United States should know these facts. They should become aware of the problems and dangers inherent in this type

of program. They should know that a similar plan called Compulsory Health Insurance is *now* in the hands of our Social Security Agency in Washington. It was before the 82nd Congress. It is a plan copied from the National Health Service of Great Britain. If adopted, as now proposed, for the U. S. A., it may cause the same problems and hardships among optometrists here as it has in Great Britain.

It is obvious that many citizens do not understand the regimentation and additional tax burden which accompanies socialized medicine, or which would accompany Compulsory Health Insurance—regimentation of both the doctors and the patients. This, accompanied by the inevitable decline in standards of service and care which accompanies bureaucratic administration, gives optometrists a duty to perform in the patient's best interest by resisting with every means at their command any insidious proposals which may confront them in the coming months.

CAREL C. KOCH

CURRENT COMMENTS

Virginia Huck
Editorial Assistant

Optometrists will confer a favor by sending news items of general interest for this department: such as relate to new instruments, clinical techniques, education, visual health and optometric legislation and organization.

BAILEY ADMINISTRATIVE DIRECTOR OF A.O.A.

Our interest was aroused considerably last June when the A. O. A. announced it had created a new post of Administrative Director at the Miami Beach Congress. Why had the A. O. A. created the job, we wondered. What would be the responsibilities of the job? Where did they find the man to fill the position? What was he like?

We didn't have to wait long for the answers. In the middle of July, the young man from California appointed to the job came to Minneapolis to see A. O. A. Secretary Ernest Kiekenapp, and we took the opportunity to interview him. Tall (6′ 1″), dark (crisp, black hair, brown eyes) Harold Bailey answered our questions most graciously and clearly.

"Why was the job of Administrative Director created? Well, the A. O. A. president has become so burdened with detail work that he can't make the contacts he should. It will be my job to relieve him of some of the detail work, so he can get out. I'll make some of the contacts, too, especially with the State associations," Bailey explained.

"The A. O. A. long range goal is to centralize—get all the offices in one city. Perhaps Chicago. That's where I'll be of some help, too. I'll make a study of the entire situation and make recommendations. Of course, this can't be accomplished over night."

"What am I doing now? Well, I guess you'd say I'm going through a period of indoctrination—getting acquainted with A. O. A. people and policies."

Thirty-seven year old Bailey brings to his job a background of 17 years' experience in the management end of organizational work. (He's never been satisfied to do just one job, and usually has studied nights or carried on volunteer civic work along with his job.) Following graduation from Whittier College (California) in 1935, with an A.B. degree in Sociology, he worked as a Y. M. C. A. membership secretary (1935-1942); managing director of the Hollywood U. S. O. (1942-1944); then a two-year break to serve in the United States Navy (1944-1946). From 1946-1952, he served as assistant executive secretary of the California Osteopathic Association and Executive Secretary of the California Osteopathic Hospital Association. In all his assignments, he has also served in a public relations capacity in addition to other responsibilities.

We found "Hal" Bailey to be a direct, quietly forceful conversationalist who didn't pull punches—a young man with a flare for showmanship and a desire to work hard. He is definitely not a "yes" man, and our impression is that he can be an invaluable aide to President Wahl in his direction of A. O. A. affairs.

After getting acquainted with the various A. O. A. offices, Bailey plans to return to Anna, Illinois, where he has already spent a month helping Dr. Wahl. His wife, Jeanne, and their three sons, have already moved from Montebello, California, and settled in Anna.

"From now on, it looks like I'll be up to my ears in work, and that's the way I like it," Bailey told us. And after talking to him, we believe he meant what he said. Which bodes well, we feel, for the A.O.A.

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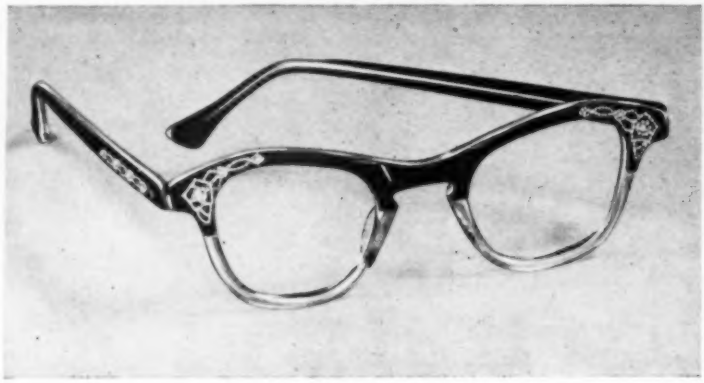

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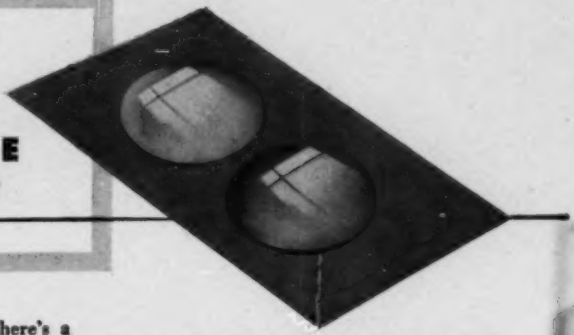
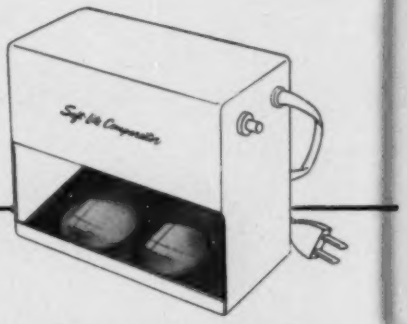
WHAT'S THE DIFFERENCE BETWEEN THESE TWO LENSES?



These lenses *look* alike — but there's a world of difference between them. For instance, one of these lenses offers true neutral transmission of light in exactly the same manner as white crown lenses; the other does not. One of these lenses is available in five degrees of absorption; the other is not. One of these lenses is ground on Orthogon curves for the elimination of marginal astigmatism; the other is not. The glass for one of these lenses is made in the only exclusively ophthalmic glass plant in the country; the other is not. One of these lenses is available in forms for almost any Rx; the other *may* be, but you don't know for sure.

HOW CAN YOU TELL THE DIFFERENCE?



You can easily tell the difference between these two lenses merely by placing them in the Soft-Lite Comparator and noting that Soft-Lite Lenses transmit light in exactly the same fashion as white lenses. Ordinary tinted lenses do not. In addition, Soft-Lite is the only flesh-colored absorptive lens ground to Orthogon curves; the only absorptive lens available in five shades and in most Bausch & Lomb lens forms. Soft-Lite is the only flesh-colored absorptive lens which transmits light evenly and naturally, exactly the same as white crown lenses.

THERE IS A DIFFERENCE . . .

between Soft-Lite and other absorptive lenses. The difference can be *shown*. Specify Soft-Lite instead of "tint" — your patient will be glad you did!

Soft-Lite Lenses

Featured in Orthogon

Some eyes can take it . . **. . . some eyes cannot!**

Another Trend? Yes!
THE SHURON "RONBELLE"
...the newest member of the BROWLINE frame family
Shuron started the trend to half-zyl frames which follow Nature's accent of beauty, the brows—a trend which over thirty factories have imitated, but none has truly copied. Now, with bridges of 1/10 12k gold filled, you may continue to look to Shuron to provide the most tastefully designed styles. "Ronbelle" joins the BROWLINE family as another best-of-all!
8 Colors: Chestnut Amber, Cordovan, Mocha, Blue, Green, Burgundy, Bronze, Ebony. Eye sizes 42, 44, 46; D.B.L. 18, 20 and 22. From Independent Suppliers.
Shuron®
SHURON OPTICAL COMPANY, INC.
GENEVA, N. Y., Established 1864

This Shuron product is covered by one or more of the following U.S. patents: DES-107106 • DES-129710 DES-141744 • DES-141743 • 1984541 • 2257966 • 2301328 • 2329100 • 2332160 or applied for.